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WATER SUPPLY, & SANITARY IMPROVEMENT.

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PATENT SELF-ADJUSTING & COMPENSATING GAS-METERS.

MANUFACTURED BY

CROSLEY & CO.,

103, SOUTHWARK BRIDGE ROAD, LONDON.

REPORT ON CROSLEY AND GOLDSMITH'S PATENT METERS.

London, November 17, 1858.

Having been invited by Mr. William Crosley to examine the performance of the gas-meter recently patented by himself and Mr. Goldsmith, and manufactured by the firm of Crosley and Co., of 103, Southwark Bridge Road, we assembled at their manufactory, and now report the result of our examination.

We did not think it necessary to check the accuracy of the testing gas-holder employed, as Mr. Barlow had done this on a prior occasion; and he assured us that he had found the index to agree, foot by foot, with a standard cubic foot measure containing 62·321 lbs. of distilled water, at the temperature of 62° of Fahrenheit and a barometric pressure of 30 inches, being the standard of measure established by law. Our first care, therefore, was to so adjust a 20-light experiment-meter that its registration coincided exactly with the index of the testing gasholder, which meter we subsequently used as the standard testing meter in the experiments hereinafter recorded, taking care from time to time to check its accuracy by the gas-holder.

The chief novelty in Messrs. Crosley and Goldsmith's meter consists in an ingenious contrivance for maintaining the water at a uniform level, so that the capacity of the measuring-chamber shall not be affected by a deficiency or by an excess of water. It is well known that the registration of ordinary wet gas-meters, and more especially of the smaller sizes, is liable to considerable variation from this cause; and we consequently selected a 3-light meter for our first series of experiments, and commenced by subjecting it to the severest and most unfair test to which any meter can be put—that is, by adding lights till they commence to burn unsteadily. In this manner, a 3-light meter was tested with 10 lights, with the following results:—

EXPERIMENT *No.* 1.—3-*Light Patent Meter.*

Number of Lights supplied.	Duration of the Experiment.	Consumption by Test Meter in Feet.	Consumption by Patent Meter in Feet.	Variation per Cent. in Index of Patent Meter.	Rate of Consumption in Feet per Hour.	Friction of the Meter in Tenths of an Inch of Pressure.
10	m. s. 30 23	25·36	25·00	1·44 slow	50·08	6·2

During the course of this experiment we added 10 cubic inches of water, without producing any appreciable effect upon the registration or upon the steadiness of the lights. We then reduced the number of burners to 3.

EXPERIMENT *No.* 2.—3-*Light Patent Meter.*

Number of Lights supplied.	Duration of the Experiment.	Consumption by Test Meter in Feet.	Consumption by Patent Meter in Feet.	Variation per Cent. in Index of Patent Meter.	Rate of Consumption in Feet per Hour.	Friction of the Meter in Tenths of an Inch of Pressure.
3	h. m. s. 1 13 5	19·67	20·00	1·67 fast	16·15	1·8

We continued adding water by 5 cubic inches at a time during this experiment, till 20 cubic inches had been added in all, without flooding the syphon or altering the ratio of difference between the two meters; but with 45 cubic inches of water the syphon became flooded, and the lights were extinguished.

Our next experiment was with 1 light, by which means we obtained the results of experiments with the maximum and with the minimum rate of consumption of which this sized meter is capable.

EXPERIMENT *No.* 3.—3-*Light Patent Meter.*

Number of Lights supplied.	Duration of the Experiment.	Consumption by Test Meter in Feet.	Consumption by Patent Meter in Feet.	Variation per Cent. in Index of Patent Meter.	Rate of Consumption in Feet per Hour.	Friction of the Meter in Tenths of an Inch of Pressure.
1	m. s. 50 0	4·91	5·00	1·83 fast	5·89	1·1

The extreme range of variation from absolute truth to which the meter is liable, is therefore between 1·44 per cent. slow and 1·83 per cent. fast, till the surplus-water reservoir is exhausted, when the meter becomes an ordinary one; but when it is borne in mind that this reservoir contains 54 cubic inches of water to compensate for evaporation—that some ordinary high-spouted 3-light meters are liable to variations to the extent of 60 per cent., according to the height of the water-line, and that the tolerated variation is 4 per cent. at the adjusted water-line—it is evident that the objects aimed at by the inventors have been in a great measure successfully attained.

We continued our experiments by subjecting a 20-light meter to similar trials, commencing with 38 lights.

EXPERIMENT *No.* 4.—20-*Light Meter.*

Number of Lights supplied.	Duration of the Experiment.	Consumption by Test Meter in Feet.	Consumption by Patent Meter in Feet.	Variation per Cent. in Index of Patent Meter.	Rate of Consumption in Feet per Hour.	Friction of the Meter in Tenths of an Inch of Pressure.
38	m. s. 8 17	19·94	20·00	0·3 fast	144·4	1·75

We then added water till the syphon became flooded and the lights extinguished, which took place by the addition of 70 cubic inches of water. We then repeated the same experiment with 60 cubic inches of water, added after the overflow-plug had been replaced.

EXPERIMENT *No.* 5.—20-*Light Meter.*

Number of Lights supplied.	Duration of the Experiment.	Consumption by Test Meter in Feet.	Consumption by Patent Meter in Feet.	Variation per Cent. in Index of Patent Meter.	Rate of Consumption in Feet per Hour.	Friction of the Meter in Tenths of an Inch of Pressure.
38	m. s. 8 8	19·94	20·00	0·3 fast	147·0	1·75

It will be seen that the registration was not affected by the additional quantity of water; but, being desirous of trying the effect of passing a larger quantity of gas, and there being no means of burning more, we opened a cock leading into a chimney-flue by which the gas could escape.

EXPERIMENT *No.* 6.—20-*Light Meter.*

Number of Lights supplied.	Duration of the Experiment.	Consumption by Test Meter in Feet.	Consumption by Patent Meter in Feet.	Variation per Cent. in Index of Patent Meter.	Rate of Consumption in Feet per Hour.	Friction of the Meter in Tenths of an Inch of Pressure.
Not determined	m. s. 6 55	19·99	20·00	0·05 fast	173·4	2·25

It now only remained for us to ascertain the effect produced by reducing the consumption to a low rate; but, as the burning of 20 feet of gas through a single burner would have occupied several hours, we thought our object would be sufficiently accomplished by burning four lights.

EXPERIMENT *No.* 7.—20-*Light Meter.*

Number of Lights supplied.	Duration of the Experiment.	Consumption by Test Meter in Feet.	Consumption by Patent Meter in Feet.	Variation per Cent. in Index of Patent Meter.	Rate of Consumption in Feet per Hour.	Friction of the Meter in Tenths of an Inch of Pressure.
4	h. m. s. 1 6 40	19·87	20·00	0·65 fast	17·8	0·9

The surplus water-reservoir will hold 208 cubic inches of water, available to compensate for the waste by evaporation; and, as the meter will register correctly with a surplus of 60 cubic inches, there is ample provision both for the abstraction of water by evaporation and for an increase by condensation.

We also tested the effect of suddenly opening and closing the gas supply-cock, and found no inconvenience to arise on this head. The flow of gas was steady and uniform, and the pressure was not sensibly affected by the action of the pumping machinery.

Our experiments lead us to the conclusion that the patent meter is a practical and substantial improvement upon the ordinary wet gas-meter, inasmuch as the capacity of the measuring-chamber is not diminished by an excessive supply of water, nor can it be increased by drawing off water. On the one hand, therefore, the consumer is protected against any intentional or negligent overfilling of the meter, the result of which is to exaggerate the registered quantity of gas actually consumed; and, on the other hand, the gas manufacturer is protected against the fraudulent abstraction of water by the consumer, the effect of which in the ordinary meter is to cause it to register less gas than is really supplied. Time alone can determine whether these advantages are gained at the expense of its durability, or by any complexity which may render its utility doubtful; but, so far as we are able to form an opinion upon these points, the patent meters are not liable to any greater derangement than the ordinary wet meters, nor do we believe they will be less durable.

We ought to remark that these meters require to be adjusted and tested after being worked a short time under pressure, in order to give the pumping apparatus sufficient time to raise the water to the proper level in the measuring-chamber. Should this precaution have been neglected, the meter will register rather more than the correct quantity of gas supplied after that level has been attained; and this is an error into which persons who are accustomed to the testing of ordinary wet meters are liable to be led in testing the patent meters.

We have already condemned by implication the practice of transmitting more gas through a meter than it is intended to supply. That quantity is regulated by manufacturers generally upon the basis of 100 revolutions of the measuring-drum per hour, and any increase upon this speed is attended with such diminution in the effective pressure of the gas after it has passed the meter, that our having made experiments at greater speeds must not be taken as an expression of our approval of the system of propelling meters at three or four times their proper speed; on the contrary, we condemn it strongly, as involving an increase in the pressure at which the gas will have to be supplied in the mains, and a consequent augmentation in the leakage.

(Signed)

GEORGE LOWE, *C.E., F.R.S., Engineer-in-Chief to the Chartered Gas Company.*

JOHN KIRKHAM, *C.E., late Engineer-in-Chief of the Imperial Gaslight Company*

GEDDIE PEARSE, *late Engineer-in-Chief to the Incorporated and Provincial British Gaslight Companies.*

THOMAS G. BARLOW, *Civil and Consulting Gas Engineer.*

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NOTICES.

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THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, NOVEMBER 23, 1858.

NOTES UPON PASSING EVENTS.

THE operations of the Metropolitan Board of Works in the formation of the new street in Southwark have already raised a question of very considerable social importance—a question, be it observed, which, although frequently brought before the world, has not hitherto obtained the attention it merits. This is, in fact—what is to be done to replace the dwellings of the poor, pulled down to allow modern improvements to be effected? or, in other words, how are the unvested rights of the humbler classes of our fellow-citizens to be protected, or compensated for, in the bitter struggle for self-aggrandizement raging around us? Improvements must needs take place; but who is to take the part of the helpless poor, who are driven from their homes in order that the rich may enjoy greater ease and comfort? Nor does this question rise alone in London. In Edinburgh and in Paris it seems to force itself with equal urgence upon the attention of the governing class; and as in the triumphal pageants of old a person was always found to remind the proud conqueror that he was but mortal, so, at present, the necessity for considering what is to be done for the persons displaced, in order to allow our civilization to develop itself, forcibly recalls to our minds the complex nature of the social state in which we live and move.

The new street about to be formed in Southwark will, indeed, sweep away many clumps of buildings now inhabited by the poor, and alas! too often, we fear, by the dangerous classes of society. The latter classes will thus be driven from their old haunts, and no doubt the kind of houses about to be built upon the line of the street will both increase the nominal rateable value of the respective parishes, and diminish the apparent rate of mortality in them. It is hardly probable that the Metropolitan Board of Works will renew the blunders of the Corporation of London, or of the Westminster Improvement Commissioners; or that it should leave the ground it is about to clear unoccupied, in consequence of its obstinacy in asking for terms which no reasonable person would consent to accept. But the more reasonable the Board may be, the more certain it is that the people who formerly occupied the land about to be built over must be driven from their old homes, and where they are to resort must be considered by some one able and willing to examine all the bearings of this complicated but important problem. There has been much sentimental twaddle uttered upon the subject; many conscientious, though misguided, efforts have been made to alleviate the distress occasioned by the so-called works of improvement. But the skeleton is still in our banqueting-hall; the voice still rises from the ground—"What have we done for our poorer brethren when, for the sake of improving the beauty or the commodiousness of our towns, we sweep away whole quarters of what we are pleased to designate as foul dwellings?" Most earnestly, then, do we urge the parties who are able practically to solve the questions thus raised, to devote their attention to them.

And, indeed, it is a practical solution which is required, for the days have gone by when vague declamation or magniloquent sentimentalism could satisfy the public mind in this, or in other, matters of such moment. Private charity, too, has been proved to be unable to cope with the necessities of the case; and the results of the well-intended, though misdirected, efforts of the persons who erected the various Model Lodgings about London, show that, after all, the safest dependence of even the poor themselves is to be found in the ordinary motives of worldly prudence, rather than in the occasional efforts or sacrifices of their friends. Twenty or thirty model dwellings for model poor will, it is to be feared, have little influence upon the habits, or upon the fates, of the countless thousands of hewers of wood and drawers of water in our Metropolis; and even under the most favourable aspects of the case, the efforts hitherto made appear to have been addressed to the wrong classes. What is really wanted is some practical measure which should benefit the labourers who are only able to earn on the average their 12s. a week—not a measure for the benefit of those earning 30s. a week, and therefore well able to pay the rents of the Model Lodgings as now arranged. Under the existing system of local taxation, it seems to be difficult to devise any scheme which should facilitate the erection of whole districts of houses exclusively devoted to the poorer labourers; but until this be done on such a scale, and under such conditions, as to render convenient lodgings for the very poor productive investments for speculators, it will be useless to attempt to palliate the evils arising from the destruction of the lower class of houses in order to make way for new streets. It strikes us that something like an equalization of the poor's rates, and a modification of the whole system of local, or of governmental, taxation in favour of houses let out in small holdings, might relieve much of the existing suffering, and enable speculative parties to erect dwellings such as the poor really desire. But then arises the question as to the right of society to step between the poor and the consequences, perhaps, of their own extravagance or want of energy? It is often a mistaken charity to shield men from the bitter lessons of adversity, or to deprive them of a stimulus for their exertions; certain it is, that the poorer classes who have been the most actively cared for and the most zealously protected, are precisely those who are the least able to take care of themselves. In urging, therefore, the persons connected with the improvements about to be made in the Metropolis to think of their poorer neighbours, and of the disturbance about to be made in their habits, it must not be understood that we advocate any distinct interference with ordinary business relations. All that we do ask is, that whilst our municipal bodies labour for the embellishment of the great towns, they should seriously weigh the effects of those embellishments upon the class which is the least likely to profit by them.

Whatever is done, however, for the benefit of the poor must, we repeat, be done upon a far more philosophical and rational system than the one lately adopted by the "educated men" who have created new epidemics, and have disturbed all the municipal law of the country. Some recent proceedings in our police courts have, indeed, painfully illustrated the mischief which must follow from all hasty and empirical legis-

lation on these matters; and it would be difficult to find a more bitter satire upon the blind guides, whom the nation has so long tolerated, than may be discovered in the proceedings under the Act for preventing Interment in Towns. No doubt it was very desirable that the practice of town burials should have been put a stop to; but the old system of interment had created a class of interests which, either from ignorance or design, the stupid or dishonest framers of the present law omitted to provide for. The consequence has been, that the parties holding mortgages upon some of the more densely-filled cemeteries, have foreclosed upon the proprietors who had been ruined by the application of a law hastily prepared, and never fairly discussed. Again: it is very pretty, no doubt, for the parties connected with the Privy Council to issue orders that the grounds wherein they forbid interments shall be covered with earth to a certain depth, and that the footpaths shall be made of asphalte. But what is earth, in the first place? and why is not Yorkshire stone as good as asphalte, in the second? When we see that Edwin Chadwick, Esq., C.B., is a shareholder in the attempted Omnibus Monopoly, and we know that officers of the Board of Health have had a direct interest in the sale of some goods which their colleagues recommended, the supposition naturally arises that the selection of the asphalte may be attributable to interested motives. But however that may be, it seems that the whole of the recommendations of the Privy Council are a juggle and a farce. Supposing that the proprietor of a recently-closed cemetery refuse to obey—what then? Supposing that he obey the letter of the law, and that temporarily he should cover the ground with something called earth—a word not yet legally defined—and that the mortgagee immediately afterwards carry away that earth, and use the ground for building purposes in consequence of his right under mortgage—what then? There have been already several painful cases of desecration of the burial-grounds of London, and doubtlessly there will be more ere long; but surely all this ought to have been foreseen and guarded against when the old law on the subject was upset by the mischievous theorists, or jobbers, who have succeeded so long in deluding our "*poco curante*" Legislature.

It might be possible, now that the first step has been taken in this matter, to make the cessation of the interment of the dead in our towns contribute to the supply of a serious and a growing want of the living. We mean that the land, formerly occupied by the intramural burial-places, might easily, and without any shock to popular prejudice, be, after a certain time, turned into play-places for the countless swarms of children now exposed to the dangers and temptations of the streets. Of course the feelings of the surviving relations of those who sleep below, after life's fitful fever is o'er, must be respected. But surely they would at any time prefer that the health and pleasure of the rising generation should be benefited, than that the ground wherein their dear relatives repose should be converted to the ordinary purposes of trade. This question of play-places for the children of the poor must soon force itself upon society; for it is tolerably certain that much of the disease, and many of the tendencies to crime, amongst those children are to be attributed to the impossibility of removing them from the physical and moral contamination of the highways. There was a talk last year about an association for providing play-places for the poor. What became of it?

We observe that the *Times* has lent its vast influence to the promulgation of the very false statements made by the Registrar-General with respect to the comparative rates of mortality at Liverpool and at Ely; and that, unfortunately, too many of the country papers have contented themselves with copying the errors thus propounded. But we would beg such of our contemporaries as may peruse these lines to observe, firstly, that the statistics of the Registrar-General with respect to Liverpool have been proved to be incorrect; and that, secondly, even if they were correct, it would be worse than absurd to compare cases which are so manifestly dissimilar as the ones selected. Liverpool is a great commercial, "emigration," and manufacturing town, with a rapidly increasing population, and an abnormal rate of births. Ely, on the contrary, is an inland, agricultural town, pursuing the even tenour of its way, with only the normal rate of increase. It is utter nonsense to compare such towns, even truthfully; but when the comparison is made on notoriously false data, what are we to think of the men who institute it, or of those who take their dicta for gospel? We shall return to this subject.

Yet the real facts with respect to the state of some of our provincial towns are such as to justify a serious examination of the secondary causes likely to produce them. Thus we observe that in the pretty little town of Arbroath, on the healthy eastern coast of Scotland, the rate of mortality has recently been as high as 36 in 1000, whilst the average rate for all Scotland has not exceeded 21 per 1000. No doubt much of this exceptional mortality is to be attributed to the foul state of the Brothock, and to the miasmas produced by the chemical action of the tidal waters on that river, which constitutes the main drain of the town. But there must be a number of other causes at work to produce the above fatal result, and it behoves the municipal authorities of this "gude town" seriously to examine wherein their arrangements are deficient. It may be that the principal industry of this locality is unfavourable for life; but we suspect that the defective state of the sewerage and of the water supply, together with the general neglect of sanitary laws, are to be considered the immediate causes of a mortality so fearful as the one actually prevailing in Arbroath.

Then again, in the thriving little town of Wisbeach we observe that the rate of mortality is at present somewhere about 28 per 1000—although the town has been for some time under the protecting influence of the Board of Health. It may be that the extraordinary series of experiments to which the river Nene has been exposed, may have thrown difficulties in the way of the establishment of water-works, or of the execution of a complete system of sewerage; and it would certainly be dangerous to attempt to carry out any important sanitary works, when it is possible that the whole of the hydrographical arrangements of the district may be changed within a few months. It would be difficult to discover, it may here be stated, in the whole history of modern Engineering, a more discreditable story than the one connected with this river, unless we turn to the experiments of the Board of Health itself. The most eminent engineers have, one after another, tried to carry out their views for the improvement of the Nene, and one after the other they have failed so egregiously that the river is now in a far worse state than it was some years since, and the whole of the surrounding districts are suffering from the recent interferences with the discharge of flood or land waters. Unfortunately, or perhaps fortunately, the commercial interests of Wisbeach, and indeed of the whole neighbourhood, have also been affected by the changes lately produced in the Nene. Will the pecuniary injury inflicted by the empirical Engineering of late years cause the municipal authorities of these parts to bestir themselves? If it should produce this result, incidentally a portion of the energies of those bodies might be usefully directed towards reducing the rate of mortality in such towns as Wisbeach, to that which is said to prevail in Ely. If the mortality in the latter town really be only 17 per 1000, why need that of Wisbeach be 28 per 1000? or that of Arbroath 36 per 1000? The latter rate is positively worse than the one prevailing in Amsterdam!

At Dover we observe that a great deal of irritation still prevails on account of the practical result of the (so-called) sanitary works; and that especially the charge entailed upon the general body of the ratepayers for the water supply is beginning to attract the attention of the parties who are not personally interested in maintaining the existing arrangements. It appears that the net receipts from the water consumers were only £597. 14s. 2d., whilst the gross expenditure for the water-works was not less than from £1200 to £1500; and it would even seem that no sum to cover the interest on the capital invested in the water-works is included in this latter amount. Evidently, then, the ratepayers pay for the convenience of the water consumers; and the inhabitants of the town do wisely in instituting a rigid inquiry into the matter. But that which so naturally shocks the ratepayers of Dover must occur in numerous other towns; and if the deluded mortals who yielded themselves to the guidance "of the educated men who could and would combat epidemics," would also examine the results they actually have obtained, they would find that really they have only shifted some of their local burthens from the shoulders of those who could, and ought to, bear them, to the shoulders of those who cannot defend themselves. The social injustice of the principle upon which the Public Health Act, 1848, was founded is, indeed, only equal to the ignorance and incapacity of some of the men employed to carry that Act into effect; and the case of the Dover Water-Works is by no means an exceptionally bad or unfavourable sample of the results of the system.

One of the saddest tales of the day is, however, that of the

winding-up of the Woolwich and Plumstead Water-Works Company. For a long time it seems that this Company has been in difficulties, but its Directors struggled on, with the occasional assistance of a puff of their "softening process" by the new Engineering lights. Tradesmen, however, have no respect for sanitary theories; and as the members of that prosaic body to whom the Woolwich Company was indebted were not disposed to carry out an interesting experiment at their own expense, the application of the softening process on a large scale has come to an untimely end. "*Sic transit gloria mundi.*" We hope that the foreign governments which were disposed to believe the wonderful tales of Mr. F. O. Ward, will hear of this signal commercial failure of one of the systems he recommended, at the same time that they hear of the commercial failure of the Rugby sewerage irrigation.

In a previous portion of these notes we called attention, in a cursory manner, to the state of the river Nene; but it appears that, nearer to the metropolis, it would be desirable to adopt measures for the protection of some other great arteries of commerce. The Medway is rapidly becoming unsuitable for navigation; or, at least, such is the belief of the majority of the dwellers on its banks. Now the danger to the navigation, if real, must arise from the gradual shoaling of the bed; and certainly such a state of things must affect the sanitary condition of the surrounding districts. Naturally we ask what the Hydrographical Board of the Admiralty has been about whilst this process was going on? or what steps the General Board of Health, or their brass-plated successors, have taken to prevent epidemics? Little or nothing, of course; but surely such bodies, if meant to do anything, ought rather to teach local authorities how to avoid evils than to remedy the evils when produced.

But if official science thus occasionally nods, private enterprise is not without its accidents. The recent "break down" of the Norwich Water-Works shows that there is extreme danger in leaving the supply of a large town dependant upon only one steam-engine. Again, the bursting of the large main of the West Middlesex Company in the Grand Junction Road proves that even after several years' actual use, cast-iron pipes are liable to accidents of the most unaccountable nature; whilst the angry feeling we are so grieved to observe to prevail between the parochial authorities of South London and the executive of the Southwark Company must eventually be injurious to both parties in the dispute. It is hardly our place to express opinions on these last-named matters in their early stages; but we trust that neither of the parties we thus refer to will be offended at our reminding them, firstly, that public companies cannot exist without being allowed to make a fair profit; and, secondly, that the companies cannot make a profit if they enter upon an unnecessary course of opposition to popular opinion. Substantially, the interests of companies and of the public are identical; a little consideration on either side would marvellously advance the interests of both.

A stray copy of the Weekly Return of the Health and Meteorology of the Metropolis—apparently published by the General Board of Health, though that body had ceased to exist before the day of publication of the copy we hold—has recently been forwarded to us. It might, perhaps, be worth the while of some economical Member of Parliament to inquire who pays for these documents. Costly they must be; but, at best, they are only pale reflexes of the Registrar-General's returns. Why have these things in duplicate?

ON THE SANITARY INFLUENCE OF BUILDING MATERIALS.

In the course of some recent professional visits to rather distant places, we have noticed the prevalence of certain fashions in house building—the adoption in certain towns of particular modes of domestic construction; and at the same time we have been struck with the marked influence of those architectural details upon the healthiness and the comfort of the buildings in which they are applied. It appeared to us that it might, therefore, be worth while to dwell a little upon the investigation of the nature of the influence so produced, if it were especially of that class likely to affect the sanitary condition of houses.

It must not, however, be understood that the conclusions to which we have been thus led are so cogent as to induce us to present, or even to consider, them in the light of inflexible laws. Local considerations of economy, it may often be local fiscal arrangements, may render it advisable to use some materials, or to build in certain styles, which a strict adherence to philosophical laws would, under normal circumstances, induce an architect to avoid. The very style of decoration adopted also often renders the use of certain materials indispensable; just as, on the other hand, the occurrence of such materials in particular places exercises a reflex influence on the form and expression of the Architecture they, as it were, impose. All these things require to be taken into account in every particular case, and the general laws hereinafter sketched forth, must be modified in their application to meet the exceptional conditions of that case. But it is hoped that good will be effected even by the simple attempt to ascertain the co-relation which must exist between the healthiness of a dwelling and the materials of which it is composed. An examination of the reasons for the retention of any local custom, whether in building operations or in any other matters, must indeed be productive of good, if it be only on the score of its explaining the origin of the custom; but if such examination should lead to the recognition of the danger attending an adherence to old methods, it may become a great source of benefit to society. Illustrations both of the reasonableness and of the absurdity of many old customs in building will be furnished in the course of the following observations.

The primary hygienic conditions to be aimed at in house building are, that the dwellers in the houses should be protected against all external atmospheric accidents, then against any noxious influences exercised by the ground itself, and, lastly, against any deterioration of the internal atmosphere. The first of these conditions is to be obtained by the judicious use of impermeable, non-conducting materials; the second by the use, in some positions, of impermeable, non-absorbent materials, and by carefully combating the tendency of earth-damps and vapours to rise in the buildings, but in others by the use of certain descriptions of absorbent materials; whilst the last condition may even furnish an objection to the use of the very absorbent materials it might be desirable for other reasons to employ. Indeed, the hygienic importance of building materials is of a more serious and a far more complicated character than it is usually considered to be.

The particular precautions to be taken for the protection of buildings against external atmospheric influences, are regulated by the positions which the materials of which they are composed respectively occupy. Thus, in upright walls the use of moderately impermeable materials may be tolerated, whilst upon the weather-beds of cornices and upon roofs it is necessary to employ only those which are practically impermeable, and upon flats to use exclusively the denser metals. But in the selection of the moderately impermeable walling materials—such as stones and bricks, limes and plasters—it is essential to pay attention to the "exposition" of the building, for the relative proportions of rain and of sunshine upon an exposed surface will materially affect, not only its hygienic conditions, but its durability. Generally speaking, in north-western Europe the greatest amount of rain is brought by the south-west winds; but the higher degree of temperature to which walls having a southerly aspect are exposed, ensures the more rapid and more perfect evaporation of the atmospheric moisture they may have thus received. If, in addition to this source of danger, the northern side of a building should be unfavourably placed with regard to light and air, it would become more particularly necessary to employ in its erection the more impervious materials; and the constant dampness, as well as the rapid decay of the inner walls of the courts of Parisian houses which face the north, may be cited as an illustration of the danger of using inferior materials in such positions. In situations exposed to the direct action of the sea breezes, however, there is another important consideration to be taken into account—namely, that the rains they drive into walls, or the humidity they may communicate, are likely to deposit a fine salt in the pores of the materials, which is always in a species of deliquescent state. The salt, in fact, absorbs with remarkable avidity any moisture in the air, and gives it out again in the form of a condensed vapour over the exposed surfaces. Naturally, this particular action is most strongly exhibited on the side of a building exposed to the prevailing winds; and it may be distinctly observed on the south and south-western faces of buildings erected of Caen or other soft stones, or of soft bricks, upon the shores of the Channel. In very exposed situations in the interior, as upon lofty plateau or mountainous districts, the faces of detached houses receiving the unbroken action of the prevailing winds, require greater precautions than they do in

towns or low-lands, and the remarks above made with respect to the influence of sunlight and warmth have also less bearing. In such situations the wind actually drives the rain into the building materials; and if these should be of a porous nature, they may communicate a dangerous degree of moisture to the interior of the building. The thickness of an ordinary wall is an important element of its sanitary value in these cases; but we shall have occasion hereafter to notice that the power of building materials to transmit moisture laterally is not the same as their power to transmit it vertically.

In the construction of the class of houses, known near London by the name of "speculative houses," the walls are too often made so thin that they offer hardly any resistance to the transmission of heat from one side to the other. Brickwork is not a good conductor of heat; but even though this be a recognized fact, it by no means follows that the narrowest possible limits of stability should regulate the thickness of external walls for dwelling-houses. There are few situations wherein a brick or a stone external wall of less than fourteen inches in thickness ought to be admitted, especially in exposed country districts. Unfortunately, these are precisely the districts to which Building Acts do not apply; and thus it happens that too many of the houses there erected are uncomfortably warm in summer, or cold in winter.

The characters of the materials used for roofing with inclined surfaces are amongst the most potent of the secondary influences on the architectural taste of a nation. The high pitch and the bold projection of a thatched roof have, for instance, a great deal to do with the picturesque appearance of English cottages; just as the pitch and the weighting stones of the shingle roofs of Switzerland add to the effect of the wood huts of that country. Probably the necessity for a similar high-pitched roof, when porous earthenware tiles are used, may account for the peculiar direction of the ridges in old brick-built cities; and thus furnish a prosaic, economical reason for the preference of our ancestors for "gable ends." Certain it is that in Holland, and in certain parts of our own country, tiled roofs are formed with slopes of not less than 60°, whilst in Italy, Spain, and the south of Europe generally, they are made with as flat a slope as 15° occasionally; and in the former countries the type of national street architecture is as decidedly to be found in the gable-ended houses, as it is, in the latter, in the broad overhanging eaves. The general application of slates to modern houses has enabled the inhabitants of the north to adopt, to some extent, the style of roofing formerly confined to warmer and drier climates; and it is about the period of the general introduction of slate that we must seek for the chronological history of the origin of ridges parellel to street fronts in northern Europe, those abominations in the eyes of mediævalists! Be this as it may, with ordinary small-sized slates the angle of inclination never need exceed 30°, whilst with the large slate slabs lately introduced, that angle may be reduced to as little as 15°, provided the cover-joints be well and carefully laid. In some places, of late years, a system of roofing with flat tiles bedded in cement has been applied; but unless the "fall" be considerable, and unless great precautions be taken to prevent radiation from the interior of the building through such a roof, it will be found practically to be very inconvenient. Under any circumstances an inclination of 1 in 48 should be given to the flat tiled roofs constructed as above described.

But whatever may be the mode adopted for protecting a building from the effects of the rain falling directly upon it, it is absolutely necessary, so far as the sanitary condition of the interior is concerned, to interpose some non-conducting stratum between the external surface of the roof and the interior of the habitable portion of the building. This is true, whether the roof be of metal, or of slates, or of tiles; though, of course, the degree of necessity, so to speak, will depend on the conductibility of the exposed surface and upon the purpose to which the interior is to be devoted. In dwelling-houses, at least, a space must be left under the covering of the roof, through which, if possible, air should circulate freely; and then a ceiling of the best description should be inserted. By this means the rapid transmission of warmth is prevented, and the uncomfortable heat of summer, or the equally uncomfortable condensation of the warm vapours of the interior during winter months, may be avoided. Much inconvenience is felt in greenhouses from the last-mentioned cause, and it was designedly in order to obviate it that Sir J. Paxton introduced his ridge and furrow system of glass roof—the only one which has yet successfully solved the problem of preventing any annoyance from the condensation of internal vapours on conservatory roofs.

In the case of roofs with dripping eaves, one important function discharged by them is the protection of the upper parts of the external walls from rain, which, by the capillarity of the building materials habitually employed, might otherwise extend its influence to a great depth, and with as much injury to the exterior as inconvenience to the interior. Where, then, the more porous walling materials are not thus protected by a roof, their upper surfaces must be covered by some denser and less porous material. The condition required of the latter is, that it should actually throw off the rain-water falling upon it; and therefore the impermeability of the coping or covering material is as important as its capability of resisting the effects of frost. M. Vaudoyer, in his "*Instructions sur les Moyens de prévenir, ou de faire cesser les Effets de l'Humidité dans les Bâtiments,*" mentioned a curious illustration of this fact. In the great palace of the Quai d'Orsay, at Paris, the inner walls were covered with a coping of the Cherence stone, and that material was selected for the purpose precisely on account of its resistance to all ordinary atmospheric influences, even when used in the most exposed parts of bridges. But the architect lost sight of the fact that the Cherence stone is of a porous nature; and it thence happened, in fact, that the coping formed of it did little else than retain the rain-water falling upon it during showers, to transmit that rain subsequently to the stones the coping was itself intended to protect. The Bath and Caen stones are, it may be added, as absorbent as the Cherence stone was in this case, and they ought, therefore, never to be used upon the exposed higher members of cornices or the tops of walls; or if, for the purpose of Architectural decoration, it should be necessary to employ them in such positions, their upper surfaces must be protected by a metal covering, or be rendered impermeable by some of the known methods. In the ordinary style of brick construction near London, the system adopted for the purpose of protecting the tops of walls, by the use of plain tile creasing and a course of brick on edge in cement, is very simple and effectual; indeed, it is more so than the dearer mode of covering the wall with an ordinary stone coping, unless the latter should be bedded in cement mortar, and rest upon one or two courses of brickwork, also set in cement. Glazed bricks or tiles are often used in such positions, and with success, provided that attention be paid to the quality of the mortar. These remarks with respect to copings and upper members of cornices may be extended to window-sills and string courses, or, in fact, to any parts of a building likely to receive rain-water; they must all be rendered as impermeable as possible, and the softer materials should be carefully excluded from such positions.

The earth-damps and the vapours which rise from the ground are amongst the most dangerous of the external agencies likely to affect the sanitary condition of a building; and it would be difficult to exaggerate the importance of the precautions required to counteract their effects: and these effects, it must be observed, are often as destructive to the building materials employed as they are injurious to the dwellers in the structures wherein they exhibit themselves. Thus, in ordinary walls, or those in which no effectual measures have been adopted to intercept the capillary action of the materials, the moisture from the ground will rise to a height dependant upon their powers of absorption, but in almost every case to a greater height on the inside than on the outside of the building; because the more regular temperature and more perfect evaporation upon the former facilitates the action of its capillarity. The moisture so transmitted—as has been said—is not only injurious, in a sanitary point of view, on account of the absorption of heat caused by its evaporation, but it is destructive on account of the chemical changes it produces or develops in the building materials. In damp walls there is always, in fact, a tendency towards the formation of the nitrates of soda or of lime, and the efflorescence of these salts gradually but surely disintegrates the materials of which they are composed. Moreover, as those salts are deliquescent, their mere presence upon the surface of a wall is objectionable, simply because the evaporation of the moisture they attract must lower the temperature of the surrounding atmosphere, or because the expansion of that moisture in freezing must tend to disintegrate the materials upon which it is precipitated. As to the vapours rising from the ground, the nature and extent of the injury produced by them must depend upon the soil itself. If, for

instance, the soil should be a rich alluvial one, the vapours would, in all probability, be extremely mephitic, and they would rise in the greater abundance when an active evaporation is kept up immediately above the surface. In other words, as the drier the air in the lower part of a house built immediately upon rich alluvial soil is kept, the more rapid will be the evaporation from the latter, unless some means be adopted to prevent that peculiar action; so the danger from the earth vapours will actually be increased by an injudicious application of measures which in themselves would be advantageous. It may be added that other soils than the one just named do not seem to exercise any markedly deleterious influence; unless, perhaps, the very retentive character of stiff clays be considered to place them in an exceptional category, on account of their preventing the escape of any moisture, accidentally poured over their surface, in any other manner than by evaporation.

The damp from the ground may easily be intercepted by isolating the foundations from the earth—firstly, by means of dry areas, as the open spaces around the basements of houses are called, in which a sufficient circulation of air is maintained, to allow the evaporation through the retaining walls to take place without affecting the main building; and, secondly, by placing the foundations themselves on a bed of concrete. But it must be observed that the efficiency of the concrete for this purpose depends upon the hydraulicity of the lime used in its composition, or upon its power of setting strongly and permanently under water. As the bulk of the concrete made near and in London is composed of the ordinary stone-lime, and is, therefore, of a very inferior quality, it is usually necessary, in addition to the precautions above cited, to insert above the footings of all the walls in basements, and below any sleepers or wall-plates, either a layer of slate bedded in cement and inserted between two courses of brickwork in cement, or a layer of asphalte; in some instances even a layer of sheet-lead has been used. The first of these precautions is the most economical, and generally speaking it will be found to be sufficiently effectual; indeed, when the carelessness of working men is taken into account, there seems to be good reason for preferring it to the more delicate and costly application of asphalte. Whatever precautions are, however, adopted in the construction of foundation-walls, they may be, and often are, defeated in country houses by the injudicious heaping up of the ground against the plinths of houses, in order to form flower-beds close up against the houses, or to form paths near them. The intercepting layer must, in fact, be placed *above* any possible source of humidity, whether direct or indirect.

As to the vapours which may rise from the ground enclosed within the foundation-walls of a house (and in certain positions, as in marshy land, these vapours may require to be carefully guarded against), they must be excluded from the habitable portions of the building by means of close flooring or paving, and by a perfect ventilation under the same. But it is essential to prevent the condensation of moisture upon the underside of the floor, and it is for this reason that occasionally it may be preferable to use, in such cases, the more absorbent materials, because they are not good conductors of heat, and do not therefore give rise to an important precipitation. In those parts of a house where the materials are exposed to the ordinary atmospheric changes, as in halls, staircases, &c., the inconveniences attending the use of non-absorbent materials may be distinctly perceived upon their upper surface, and from the effects thus produced it is easy to infer the amount and nature of the inconveniences which may be produced elsewhere. At all times there is a tendency on the part of the marbles, dense paving stones, or varnished tiles, used in halls and similar situations, to abstract heat from the air above them; and, if that air should contain much moisture in suspension, it will be deposited in a visible form upon the exposed surfaces. So again, any moisture rising from below will be condensed on the underside of the above-named materials, and by its subsequent evaporation it will still more lower the temperature. But if there be on this score an occasional advantage in the use of absorbent and non-conducting materials in the positions above alluded to, there may also be a serious inconvenience attached to them, from the fact that their very absorbent character renders them able to retain dangerous and unpleasant miasmas. It is precisely in such cases as these that the greatest care and discretion are required from the Engineer or Architect in the selection of the materials to be employed; and he must be guided, in arriving at his decision, more by the peculiar circumstances of the case he is considering than by any inflexible, *à priori* laws. Every house, every soil, and it might almost be said, every kind of building material, requires to be dealt with on its own merits. Singularly enough, however, the practice of many nations is, in these matters, utterly at variance with either common sense or philosophical deductions; and every one who has experienced the damp chill of a Dutch marble hall, or the permanent odour of a French *basse cour*, will at once perceive the necessity for a stricter attention to the sanitary importance of building materials than prevails in either of those countries.

The power of certain materials to absorb and retain odours is, it may be added, a very important one, at least in its bearings upon the healthiness of dwellings; just as the power they possess of conducting heat is important in its bearings upon the comfort of the same buildings. In living-rooms, for both these reasons, it is preferable to use an intermediate class of materials, such as plastering on walls, and paper upon it, in the variable temperate regions, at least; and the introduction of marble linings, or of thickly-painted and varnished wood, is as objectionable as the use of woollen, leather, or even silk hangings. But in warmer climates, or even in provision-stores or hospital wards in the cooler ones, it is often desirable to use the hardest and most distinctly conducting materials, precisely on account of their non-absorbent character—observing, of course, to maintain the surrounding atmosphere in such a state as to prevent the deposition of moisture upon the surface of the stones or marbles, &c., used. In the construction of bath-rooms, a great deal of attention is required in the selection of the materials immediately exposed to the action of the steam. Thus it will be condensed upon marble, porcelain, parian, Keene's, or other similar cements; or upon highly-varnished wood-work. But again, if the plaster or wood-work should be very porous, they will naturally retain the moisture, and as infallibly decay in a short time.

In these remarks attention has been called exclusively to the sanitary conditions affecting the application of building materials; but the manner in which they influence the artistic expression of a building would form a subject of at least equal importance. We may revert to it on some future occasion.

Circular to Gas Companies.

A DECISION of Mr. Pitt Taylor, the judge of the Lambeth County Court, in the case of *Spratt v. the South Metropolitan Gas Company*, an outline of which will be found in another column, has created considerable sensation amongst gas companies, and is so manifest an outrage upon common sense and the true principles on which trade should be conducted, that we can fully participate in the surprise with which it has been received. The plaintiff is a journeyman tailor employed in a "slop-shop," who has taken a beer shop in a poor neighbourhood at Walworth, the previous tenant of which had been a defaulter to the company. Being himself without visible means, and a formidable rival in the shape of an old-established licensed public-house existing in the immediate neighbourhood, the company refused to give credit to such a customer without security, either by the deposit of a sum sufficient to cover his probable consumption of gas for a quarter, or in some other substantial form. Unable or unwilling to do this, he proceeds against the company in the County Court for damages which he alleges he has sustained by reason of the refusal of the company to supply him with gas, and obtains a judgment for £2 and costs. The company's Act contains no clause by which the supply of gas is rendered compulsory; but the judge held that the Act itself constituted a contract between the public generally and the company, by which the latter undertook to supply gas to every person requiring it within the limits of the Act, in consideration of certain rights and privileges granted to them by Parliament, in the same manner that a railway company bound themselves to carry goods and passengers in consideration of the powers granted them to take lands by compulsion, and otherwise to interfere with private interests. But the cases are by no means parallel, as no such powers have ever been granted to gas companies, nor can they, like railway companies, retain possession of the goods till their charges are paid, or refuse admission to their carriages to a passenger who has not paid his fare. The principle of compulsory supply to private consumers has been specially recognized in several Gas Acts, but in every one of them the companies have been authorized to require reasonable security for the payment of their claims, as in the Chester, Kingston-on-Hull,

Staffordshire Potteries, Waterford, Luton, and Norwich Acts of last session, and many others. Unfortunately, there is no appeal from a judgment of a county court when the sum awarded is less than £20; and the South Metropolitan Company has consequently paid the £2, but persists in its refusal to supply the plaintiff with gas, in the hope that some means may be devised for carrying the question to the Court of Queen's Bench on a case which shall authoritatively decide upon the obligations in this respect of gas companies established by Act of Parliament.

The *Daily Telegraph* of the 16th instant contains a notice preparatory to an application to Parliament for an Act to incorporate a new company for the supply of gas to the western districts of the metropolis, which we reproduce here as our metropolitan readers may not otherwise have an opportunity of becoming acquainted with the precise nature of the project:—

BOROUGH OF MARYLEBONE GAS COMPANY (LIMITED).

(Incorporation of Company, with Power to Supply Gas to the Borough of Marylebone and neighbourhood.)

Notice is hereby given, that application is intended to be made to Parliament in the ensuing session for an Act to incorporate a company, and to authorize such company to manufacture and sell gas and coke, and also to sell coals and other substances, in the parishes of Paddington, St. Marylebone, and St. Pancras, all in the county of Middlesex; and to construct gas-works on a certain piece of land belonging to Mr. Killingworth Hedges, and situate, lying, and being in the parish of Greenford, in the county of Middlesex, and containing by estimation four acres and a half, or thereabouts, bounded on the north by the road leading from Greenford aforesaid to the Harrow Road; on the south, by the towing-path of the Grand Junction Canal; on the east, by a field, the property of Mr. Gardner; and on the west by a dyer's factory, belonging to and occupied by Mr. G. F. Perkins.

And it is proposed by the said intended Act to authorize the said company to purchase, by compulsion or agreement, the said piece or parcel of ground, and also all other lands, houses, buildings, and property, and to break up public and private streets, roads, ways, and places in the several parishes of Greenford, Harrow, Willesden, Hammersmith, St. Luke's (Chelsea), St. Mary Abbotts (Kensington), Paddington, St. Marylebone, and St. Pancras, all in the said county of Middlesex, or any or either of them respectively, and to lay down and to take up mains and pipes, and to demand and take rates, rents, and charges, and to grant exemption from payment of rates, rents, and charges, and to have, use, and exercise all powers, rights, authorities, and privileges usually conferred upon gas companies, or which would be convenient or useful for enabling the said intended company to carry out the objects of its incorporation, and to vary or extinguish all existing rights and privileges in any manner connected with the lands, buildings, and properties which may be purchased under the powers of the said Act, or which would prevent or interfere with the carrying into effect any of the objects or purposes of the said intended Act, and to confer other rights and privileges.

And it is proposed by the said intended Act to authorize contracts and agreements between the said intended company and any companies, trustees, commissioners, or other public bodies, officers, or persons, with respect to the lighting of any public streets, roads, ways, or buildings, or which may be otherwise incident to their undertaking, or proper or convenient for carrying the same into execution, and to confirm all or any of such contracts and agreements as may have been entered into by or on behalf of the said company and other parties aforesaid prior to the passing of the said intended Act.

And it is proposed by the said intended Act to authorize the said intended company to raise money by borrowing and by the creation of shares or otherwise for the purposes of the company, and to regulate the capital thereof.

To incorporate with the said intended Act, so far as may be necessary, the "Companies' Clauses Consolidation Act, 1845;" "The Lands Clauses Consolidation Act, 1845;" and "The Gas-Works Clauses Act, 1847;" or some part or parts thereof respectively, and to alter or amend the same.

And notice is hereby further given, that on or before the 30th day of November instant plans of the lands, buildings, or property which may be taken compulsorily under the powers of the said intended Act, together with a book of reference to such plans, containing the names of the owners, lessees, and occupiers thereof, and a copy of this notice as published in the *London Gazette*, will be deposited with the clerk of the peace for the county of Middlesex, at his offices at Clerkenwell, in the said county, and with the parish clerk of the parish of Greenford aforesaid, at his residence; and that on or before the 23rd day of December next printed copies of the Bill for effecting the objects aforesaid will be deposited at the Private Bill Office of the House of Commons. Dated this 15th day of November, 1858.

CHARLTON and GREENWAY, Solicitors for the Bill.

4, *Garden Court, Temple.*

The site proposed is situated about ten miles from the Marble Arch at the western extremity of Oxford Street, and the district embraced in the notice extends over large portions of the ground already occupied by the Imperial and Western Companies, and a small portion by the Brentford Company. We have failed in our endeavours to ascertain who the projectors are, or what may be their means of carrying out the project, but it is doubtless an offshoot of the existing agitation amongst the parochial authorities against the late districting arrangements of the companies, and will put to the test their ability and disposition to back their views by providing the funds required for a parliamentary contest. The difficulties to be encountered in establishing a new gas-work in the metropolis may be estimated by the necessity the projectors of this company have been under of going ten miles from the centre of their proposed district to find a site for their works; and if the recent experience of the Great Central Company is of any value, the economical and efficient distribution of gas over a large district by a single main from a distant work, is a problem more difficult of solution than it has hitherto been considered.

The writer of the City article in the *Times* of Friday last announces that a company is about to be formed for the general introduction of the light recently exhibited by the Honourable Major Fitzmaurice at Cherbourg. Its brilliancy is said to be obtained by passing common gas through a new medium, alleged to be virtually indestructible, and it is described to be equally applicable to domestic and public purposes. Extraordinary advantages are also claimed for it as regards cheapness, portability, simplicity, and purity. The letter of Mr. James Copcutt, inserted in another column, confirms the information which had reached us from abroad that the patent taken out in his name on April 21st last, and of which an abstract appeared in our issue of Oct. 26th, is the invention exhibited in Cherbourg and in Paris as the "Life-Light." The specification of another patent taken out by the same individual on May 20th was lodged on Saturday last, but as this relates exclusively (as will be seen by reference to the abstract given under the head of new patents) to the preparation of the lime employed in producing the Drummond or oxy-hydrogen and lime light, we have some difficulty in reconciling the description given by the writer in the *Times* with the patent of April 21, in respect of the advantages claimed for the new light. That patent describes two modes of manufacturing gas: one by distilling mixtures of oils, grease, or fatty matter combined with camphor dissolved in naphtha, and passing the gases or vapours through melted tin solder, or some other metal heated red hot; and in the other the patentee proposes similarly to treat coal gas, and then to pass the gas over camphorated ether. Now ether is one of the most volatile products known; it boils at a temperature of 96° Fahrenheit, and its vapour is as explosive as coal gas when mixed with atmospheric air in certain proportions; so much so, indeed, that it is dangerous to pour it from one bottle to another in the neighbourhood of a lighted candle. This property alone would proscribe its use for domestic purposes, even were it an economical illuminating agent, which it never can be, since the present wholesale price is 6s. per lb., while that of camphor is 1s. 1½d., and both would rise in price upon the prospect of an increased demand. The proposition to use camphorated ether for the purpose of increasing the illuminating power of gas, however made, we regard as perfectly chimerical. Some of the less volatile hydro-carbons, such as highly-rectified naphtha and benzole, may and have been used for this purpose by careful manipulators, and are, we believe, so used at the Greenwich and Oxford observatories for astronomical photographic purposes by permission of Mr. Lowe, whose patent for naphthalizing coal gas has still some sixteen months to run; but twenty years' experience has not shown that the process possesses sufficient advantages to induce the public generally to adopt it, and it has hitherto remained unproductive of anything except honour to its talented inventor, Mr. Lowe. We trust the shareholders in Major Fitzmaurice's projected company may be more fortunate.

If anything can add to the distrust with which photometric observations must be viewed by the public after the sorry exhibition presented by the scientific witnesses upon the recent arbitration between Mr. Croll and the Great Central Company, the report addressed by Mr. T. A. Hedley to the Luton Local Board of Health, and the correspondence to which it has led, must increase that feeling almost to contempt. An Associate of the Institution of Civil Engineers deliberately affirms either that gas loses nearly one half its illuminating power in transmitting it a few hundred yards, or that he has permitted a scandalous deception to be practised upon him without making the slightest attempt to detect and expose it. He pledges his credit, for whatever it may be worth, that when tested at the station the gas was of 14-candle illuminating power, and when tested immediately afterwards in the town it was reduced to 8 candles. Dr. Leeson's celebrated 1-candle gas experiment at the Guildhall Coffee-house is the only parallel we are acquainted with for so monstrous a proposition, but if we are not mistaken, he has long since bitterly repented of the part he took on that occasion, and has admitted that it was not a fair experiment. If Mr. Hedley has any respect for his own reputation, he will at once solve the mystery in which this matter is now involved; the Luton Gas-Works are open to him any day upon his giving the three hours' notice required by the Company's Act, and if photometry is at fault, chemical analysis will determine the question at issue with infallible precision. The subject is too important a one to be allowed to rest in its present position.

Correspondence.

THE LIFE LIGHT.

SIR,—As it is possible the public may be misled through the wrong interpretation which is conveyed in the article contained in your JOURNAL of the 9th inst., concerning the invention of the "Life Light," which, with my name, is attacked as "Old friends with new faces," I beg you will allow me, through the same medium, to correct such a premature and misguiding error by stating that the "Life" or "Universal Light" is not in any way identical with our "old friend, the Bude Light." And I beg to inform you that I have the permission of the Honourable Major Fitzmaurice—upon condition that you will kindly endeavour to correct your published error—to show you not only this great and matchless "Life Light" in any of its various applicable forms (the portable carpet-bag form included), but the beautiful photographic and other productions of its power, the same as exhibited with such success at Cherbourg, Leeds (at which latter place it was carried on horseback at midnight through the crowded streets with the most enthusiastic applause), and on the 2nd and other days of this month at Paris and its environs, where a range of three-fourths of a mile was lighted sufficient to read a paper or the hands of a watch, before the eyes of the *savants* of gas then and there present, and who very frankly admitted its superiority.

Having worked with all the forms of artificial light, I have chosen the "Life Light" as the most powerful and practicable, whether it be for a railway or other carriage-lamp, or to illuminate a ball-room or a lighthouse.

I have, however, to state that the particular translation of the words, "air and water," has occurred without my knowledge, but they have not been generally published.

The *modus operandi* and cost of these grand and simple lights will be easily explained to you and to the public anon.

JAMES COPCUTT.

26, *Kirby Street, Hatton Garden, London,*
Nov. 15, 1858.

ARNTZ'S REPORT ON THE PUBLIC LIGHTS IN WESTMINSTER.

SIR,—My attention has been called to the report of Mr. Arntz to the Westminster District Board of Works, relative to the consumption of gas by the public lamps in that district, and as my name is introduced in the printed tables appended thereto, and referred to in some journals in a manner tending to create an impression that I assisted in making the experiments in question, I have to request you will allow me to state that I was not present on any of the occasions, and that I merely lent to Messrs. Arntz and Hughes a Parkinson's experiment-meter and a governor, with some other apparatus belonging to my firm, on the strength of Mr. Hughes' representation that his friend, Mr. Wright, the engineer of the Western Gas Company, would have rendered him all the facilities he required for his experiments, but that, in consequence of his connexion with the Western Gas Company, it would not do for him to appear to interfere in the matter.

103, *Southwark Bridge Road,* WM. CROSLEY.
Nov. 19, 1858.

Register of New Patents.

973.—ANDREW SMITH, of Manchline, manufacturer of Scotch fancy wood-work, for "*Improvements in valves.*" Patent dated April 30, 1858.

This invention relates to the arrangement and construction of valvular apparatus for controlling and regulating the passage of steam, liquids, or gaseous bodies. The improved valve under one arrangement is made of brass tubing, of the kind known as telescopic tubing.

In constructing a tubular slide-valve for shutting off or controlling the passage of steam or liquids through a horizontal pipe, the valvular apparatus consists of a vertical piece of tubing, with a branch diverging from each side at right angles to the central vertical piece, through which the steam or liquid passes. The passage of the steam or liquid is shut off by means of a cylindrical valve, which works within the central vertical part. This cylindrical valve consists of a piece of tubing of the same size as the part within which it works; it is cut through longitudinally to admit of its being fitted inside the valve-casing. The flexibility of the metal causes the tubular valve to fit closely to its containing tube, so as to be steam and fluid tight. The pressure of the tubular valve may, if required, be increased by an internal spring or other equivalent contrivance. The vertical tube is closed at its upper and lower ends by metal plates, soldered or otherwise attached thereto, excepting that in the upper plate there is a small aperture for the rod by which the tubular valve is actuated. The valve-rod passes through a stuffing-box at the upper part of the valve-casing, and its inner end is connected to a piece of metal which is soldered to the internal surface of the valve. A similar knob or handle is fitted to the outer end of the valve-rod; upon pressing this knob, the cylindrical valve slides down and closes the steam or liquid passage. In this arrangement of valvular apparatus, the entire area of the pipe is open to the passage of the steam or liquid; since the valve consists only of a tube fitting closely to the casing, it offers no obstruction whatever to the flow of the steam or fluid. The tubular valve may be readily arranged to work in a horizontal instead of a vertical direction, so as to divert the flow of steam or fluid from a horizontal to a vertical direction, or *vice versâ*. In this arrangement the valve-rod is disposed horizontally, and works through an end stuffing-box by pushing in the valve; the passage of the steam or fluid is thereby stopped. With suitable modifications, these valves may be applied to all purposes where it is desired to control or regulate the passage of steam, liquids, or æriform bodies.

The claim is for—

1. The general arrangement and construction of valvular apparatus for opening and closing the passage or way of pipes, tubes, or ducts.
2. The system or mode of controlling and regulating the passage or flow of gaseous or liquid bodies through pipes or ducts by means of valvular apparatus, arranged as hereinbefore described, or any mere equivalent therefor.
3. The application and use of circular or other tubes to and in the construction of tubular valves.
4. The system or mode of enlarging or expanding the tubular valves by means of the several mechanical arrangements hereinbefore described; the said mechanical arrangements being applied for the purpose of keeping the valves distended, and thereby completely shutting off the flow of the gaseous or liquid body, and retaining the valves as long as required.
5. The system or mode of arranging and constructing valves wherein an elasticated tube is caused to slide or work within another tube or shell as hereinbefore described.

995.—WILLIAM ROSS, of Glasgow, in the co. of Lanark, N.B., brass-founder, for "*Improvements in taps or valves.*" Patent dated May 5, 1858.

According to one modification embodying these improvements, and suitable for "water-cranes" or "swan-neck" taps, the crane or swan-neck is formed at its inner end with a hollow cylindrical valve-piece, which works in a box or enlargement formed on the supply-pipe. When the tap is open, the fluid enters the crane or swan-neck through perforations round the cylindrical valve-piece, the inner end of this valve-piece being closed. In closing the tap, the cylindrical valve-piece is moved longitudinally, and the perforations are covered by a ring of caoutchouc, or other suitable flexible material, shaped spherically or conically so as to tightly embrace the cylindrical valve-piece, and at the same time serving as a stuffing for the aperture in which the crane or swan-neck works. The motion for opening or closing the tap is obtained by means of a groove and pin, so arranged that on turning up the crane or swan-neck and inclined part of the side of the groove, causes the cylindrical valve-piece to move longitudinally. It is, however, preferred to make a portion of the groove at right angles to the valve-piece, so as to prevent any discharge of the fluid until the crane is turned nearly up to its full height. The improvements are susceptible of various modifications, and are applicable to various kinds of taps or valves.

1007.—WILLIAM HEAP, of the Oldham Road Tool Works, Ashton-under-Lyne, for "*Improvements in pipes, joints, and couplings.*" Patent dated May 6, 1858.

This invention relates to a peculiar form of joint or coupling for metal pipes, whereby a more efficient and simple joint is obtained than those ordinarily in use. According to this invention, when applied to soft metal, a nut or loose collar, having an external screw-thread formed upon it, is first passed on to each of the pipes to be joined together. The two contiguous ends of the pipes are then expanded in any convenient manner, and an internal screw-threaded ring or ferrule is passed on to one of them. The two ends of the pipes are now brought in contact by screwing the ring or ferrule on to the opposite collar, so as to form a flush or jump-joint, and they are then forcibly tightened up or drawn together by further screwing (by means of a spanner) the two loose collars into the ring or ferrule above referred to. No packing is required in this joint other than a little white paint between the ends of the two pipes. In applying this invention to iron and other hard-metal pipes, the externally-screwed collars are screwed on to the ends of the pipes to be joined, in place of being loose thereon.

The claim is for—

1. The general construction and arrangement of pipe-joints or couplings, as described.
2. The system or mode of coupling or connecting the ends of pipes by employing two collars having external screw-threads formed upon them, which collars are fitted loosely upon, or are screwed on to, the ends of the pipes to be joined, and are afterwards joined together for the purpose of tightening the joint by the aid of an internally-screwed ring or ferrule, as described.

1022.—WILLIAM DUFF and JOHN GILCHRIST, of Liverpool, engineers, for "*Improvements in apparatus for measuring water and other fluids; also capable of being used as a motive power.*" Provisional protection only obtained. Dated May 7, 1858.

For this purpose is used the ordinary direct action of a steam-engine, so far as the framing, cranks, crank-shaft, and eccentrics are concerned, for working two slide-valves in the ordinary way; but instead of the cylinder and piston, a square chamber is placed, with inlet and outlet passages. Securely fastened midway in this chamber is fixed a sheet of vulcanized indiarubber, or other elastic substance, to which is connected a rod through a stuffing-box to the cranks above mentioned; the valves being properly adjusted, and the water turned on from the supply, it will flow into one of the chambers connected with the open valve; the pressure of the water will then stretch or expand the elastic substance until it fills the chamber, the contents of which being known, each stroke of the piston acting upon the cranks will give motion to the shaft, to which a worm and wheel are connected, that acts on a common index or indicator: this index will show the quantity of water or other fluid which has passed through the apparatus.

1028.—CHARLES BOTTEN, jun., of Clerkenwell, London, and NATHANIEL FORTESCUE TAYLOR, of Stratford, Essex, for "*Improvements in means or apparatus employed in measuring and in regulating the flow of gas and other fluids.*" Provisional protection only obtained. Dated May 7, 1858.

In the manufacture of dry gas-meters, with valves which slide to and fro on their seats, it has been the practice to arrange the parts so that the gas to be measured pressed upon the inside of such valves with a tendency to lift them off their seats, whilst they are kept down only by the pressure of the measured gas, whereby gas is found to pass through the meter without being measured. And one part of these improvements consists in causing

the gas to be measured by such meters to pass first into the valve-chamber, so as to press on the outer surface thereof, with a tendency by its pressure to keep the valves to their seats.

Also the inventors construct the outer rubbing surfaces of the valve, or those parts in contact with the outer edges of the seat, sufficiently wide that at each extreme motion one of these rubbing surfaces of the valve may be overhanging its seat: the object of this is to keep the valve-seats clear.

Also the improvements relate to the movable partitions or diaphragms, and consist when forming them of several plates of metal, united by leather or other suitable flexible material in employing a large central plate, and three, four, or more narrow plates around the edge, the centre plate being united to those around the edge of it, as also these edge plates to the case, by prepared leather or other suitable flexible material; and, to insure the correct relation to, or operation of, those plates in forming a movable diaphragm or partition, they are connected together by connecting links.

This method of forming movable diaphragms or partitions is also applicable to meters for measuring water and other fluids; but with such fluid-meter is employed a double set of edge plates capable in working of folding one towards the other, and with meters for measuring water or other fluids. Another improvement relates to the arrangements and construction of the valves, of which two pairs are connected to work together, each operated by a spring, with a tendency so soon as they have passed the centre of their motion to be thrown to the extreme position in one or the other direction. The connecting-bar or bars between the pairs of valves have slight play, and they regulate the supply of the water or other fluid to such measuring apparatus by causing the fluid to pass through a chamber containing a float, carried by a lever-arm attached to a valve for closing the aperture of supply to such chamber, in such manner that as the pressure of fluid increases the float rises and closes, or partially closes, the valve at the supply-passage.

In employing a movable or flexible partition to operate in closing the supply-valve in regulating the supply of gas, the inventors apply the weight to the lever-arm of such valve, with a tendency to open it, in place of, as heretofore, to close it, by which they are enabled to employ a less counterbalance weight to the partition, and they place these counterbalance weights so that by moving in or out in the rising of the partition the pressure exerted is diminished.

1029.—Robert Best, of Birmingham, for "*An improvement or improvements in illumination.*" Patent dated May 7, 1858.

The claim is for combining two or more burners, projecting flat or sheet-like flames in a horizontal or nearly horizontal plane, in the interior of a shade or dome, the said burners being situated eccentric to the axis of the said shade or dome, and being so situated with respect to the shade or dome that the flames converge towards the middle or axis of the said shade or dome, as described.

1037.—George Day, of Old St. Pancras, London, for "*An improved self-acting valve for regulating the flow of liquids.*" Provisional protection only obtained. Dated May 8, 1858.

This invention consists in the adaptation of the ordinary spindle-valve to the purpose of regulating the flow of water or other liquids, by adding thereto the common floating ball or an inverted basin.

The spindle-valve consists of a pipe or tube, within which is fixed centrally a short tube to guide the spindle working within it. On the under side of the seat is attached a connecting-piece, and on one side of the pipe a bracket for affixing the end of the float, a lever being the fulcrum on which it works; and on the other side of the pipe is a slotted guide-piece to regulate the equal rising and falling of the lever, and which acts on the seat or valve by its being fastened thereto by the connecting-piece underneath. The lever may terminate in the common floating ball, or be in the form of a basin, which, being inverted in the liquid, is kept floating by the contained air.

1068.—Joseph West, brass-founder, 234, Shales Moor, Sheffield, Yorkshire, for "*A mode of covering and securing water-taps and branches.*" Patent dated May 12, 1858.

Placed in front and over the tap or mouth of the pipes, and preferably attached to them, a plate of cast iron or other suitable material is fixed, either plain or ornamental on the face: this plate is attached and secured to the wall, or post, or plank, as the case may be, upon which the tap is fixed. Sometimes, when thought necessary, it is fastened to a stock or hollow frame of iron or other material, which serves to encase the tap, so that it may either be let into the wall or post, or may be fixed flush with it. The outlet of the tap, or the *embouchure* of the tap, as the case may be, communicates with, or discharges into, a spout or mouth in the said face-plate, to which they may be attached.

Anywhere in the said face-plate, but depending upon the construction and position of the tap, which is fixed to its rear, is formed a slot or opening for the purpose of admitting the key or lever, which opens and shuts the water-way of the said tap. The lever or key will be of a form suitable to fit the said tap, and may of course be either plain or ornamental. Also, in some cases, when thought requisite or necessary, it is proposed to fix on the rear of the said face-plate a spring, so arranged as to press against the lever or key when it has opened the tap, urging it back again whenever the force which opened it is removed, and thus prevent the water from being wasted. The keys or levers may either be arranged so as to be fixed to the cock, and remain in the said face-plate, or they may be detached.

The patentee proposes to form another aperture in the said face-plate, through which access may be had so as to screw or unscrew the plug or valve of the tap, and hence render it necessary to remove the plate, excepting for very particular purposes.

The inlet or junction of the tap is attached to a tube of iron or other material enclosing the supply-pipe, which may be let into the wall, post, or plate, as the case may be, to which it is fastened, and covered over with cement or other suitable material as may be found necessary.

The claim is for the application of a plate or cover over the mouths of branch or stand water-pipes, and also over water-taps, so as to prevent them from violence either by accident or wilfully; to prevent their fraudulent removal, and also to prevent any one from drawing off water from them but such as have a proper key to fit the tap, substantially as described.

1126.—James Copcutt, of 5, Park Place, Newland Street, Kensington, London, for "*An improvement in preparing materials employed to obtain light when using oxygen and hydrogen gases.*" Patent dated May 20, 1858.

This invention has for its object an improvement in preparing materials employed in obtaining light when using oxygen and hydrogen gases. For this purpose the gypsum or other material used in place of being employed in the same state as heretofore is first raised to, and retained for a time at, a red heat in a crucible in which a small quantity of sulphur is introduced. By which means the gypsum or other substance will be found to produce more beneficial results than heretofore.

The inventor finds in practice that a satisfactory result is obtained by mixing with the gypsum or other substance usually employed in obtaining light when using oxygen and hydrogen gases, about 5 lbs. of sulphur to a ton of the substance. The mixture is raised to a red heat in a covered crucible or oven, and is kept at this heat for about 24 hours; it is afterwards allowed to cool and cut into pieces of suitable form for use. The light is obtained by throwing an ignited jet of oxygen and hydrogen gases on to the gypsum or other substance prepared in this manner, so as to bring it to a white heat, just in the same manner as when gypsum or other substance in an unprepared state is employed.

PROVISIONAL PROTECTION

HAS BEEN GRANTED FOR THE UNDERMENTIONED INVENTIONS.

1942.—William Erson, of Cheltenham, in the co. of Gloucester, engineer, for "*Improvements in wet gas-meters.*" Aug. 27, 1858.

2312.—Joseph Pierre Gillard, of Paris, civil engineer, for "*Improvements in generating hydrogen, and in the means of, and apparatus for applying the same to lighting and heating purposes.*" Oct. 16, 1858.

2368.—Edward Clarence Shepard, of Jermyn Street, Westminster, Middlesex, for "*Improvements in electric lamps.*" Oct. 23, 1858.

2412.—Pierre Brunon, of Paris, manufacturer, for "*An improved mode of manufacturing cocks.*" Oct. 29, 1858.

2414.—John Dransfield, of Waterhead Mill, Oldham, in the co. of Lancaster, hat manufacturer, for "*Certain improvements in cocks, taps, and valves.*" Oct. 29, 1858.

NOTICES HAVE BEEN GIVEN OF INTENTION TO PROCEED WITH THE UNDERMENTIONED INVENTIONS.

1467.—William Baker, of 8, Albert Villas, Seven Sisters Road, Holloway, London, for "*Improvements in constructing covered ways for the passage of sewerage on the banks of rivers.*" June 29, 1858.

1534.—Pierre François Demoulin, chemist, and Joseph Cotelle, manufacturer, of Paris, for "*Improvements in treating the heavy oils obtained from the distillation of coals, schists, and other hydro-carbons.*"

1565.—Nathan Defries, of 5, Fitzroy Square, London, for "*Improvements in apparatus for measuring gas.*" July 12, 1858.

1703.—William Edward Newton, of 66, Chancery Lane, London, for "*Improvements in gas-meters.*" A communication. July 28, 1858.

2332.—Alexander Allan, engineer, Thomas Whimster, gas engineer, and Robert Gray, gas inspector, all of Perth, in the co. of Perth, N.B., for "*Improvements in steam-boilers, also applicable in part to gas-meters, lamps, and lubricating and other apparatus requiring a constant liquid level, and in part to pressure-indicating apparatus.*" Oct. 19, 1858.

2368.—Edward Clarence Shepard, of Jermyn Street, Westminster, gentleman, for "*Improvements in electric lamps.*" Oct. 23, 1858.

Legal Intelligence.

COURT OF QUEEN'S BENCH.

THURSDAY, NOV. 11.

(*Sittings in Banco, before Lord* Campbell *and Justices* Wightman, Erle, *and* Hill.)

BAILEY *v.* CUTTS AND OTHERS.

This was an appeal from the decision of the judge of the County Court of Nottinghamshire, held at Worksop. It appeared that the defendants were, in the year 1856, members of the Worksop Local Board of Health, and, acting in their official capacity, they had passed a resolution authorizing their solicitor to oppose a gas bill promoted by the Worksop Gaslight and Coke Company. This they did in carrying out the wishes of the inhabitants, expressed at a public meeting. The effect of the opposition was to get the price which the inhabitants were to pay for the gas, reduced from 6s. 8d. per 1000 feet, as originally proposed by the company, to 6s., in addition to other advantages. The plaintiff, who was the manager of the Retford Gas-Works, had been employed as engineer to assist in the opposition to the gas bill, and his charge for his services, £21. 14s. 6d., not being paid, he sued the four defendants, who were the members of the board who voted in favour of the opposition to the bill. The judge of the County Court held that the defendants were personally responsible, and gave judgment in favour of the plaintiff for the amount of his claim.

Mr. Serjeant Hayes was now heard in support of the decision, but

Lord Campbell said he was unable to see any contract by the defendants so as to make them personally responsible.

Mr. Bristowe, who appeared for the defendants, was not called upon.

Lord Campbell said the judgment must be set aside, but, under the circumstances, without costs. His lordship added that probably some public-spirited individuals in the parish would subscribe and pay the plaintiff's expenses.

Judgment reversed, without costs.

COURT OF EXCHEQUER.

SATURDAY, NOV. 13.

(*Sittings in Banco, before the* Lord Chief Baron, *Baron* Bramwell, *and Baron* Watson.)

HILLS *v.* THE LONDON GAS COMPANY.

Mr. Bovill said this case was tried before Baron Bramwell at the last Surrey Assizes, and a verdict was found for the plaintiff. He had now to move, on the part of the defendants, to set that verdict aside, and to enter it for the defendants, or to enter a nonsuit pursuant to leave of the learned judge upon points reserved, or for a new trial. This was an action brought

for the infringement of a patent granted to the plaintiff in November, 1849, and which originally included various matters—such as compressing peat for making fuel, for manufacturing gas, and obtaining certain substances applicable to purifying the same. There was a disclaimer in 1853, which was enrolled in 1856, and after that the title of the patent was "for an improved mode of manufacturing gas."

Baron BRAMWELL said that title was not only technically, but scientifically important.

Mr. BOVILL said it was, and several points arose upon it; but before calling their lordships attention to it, he wished to give a general view of the matter. The plaintiff's patent, so far as it related to the manufacture of gas, consisted of two parts—the purification of gas by means of hydrated oxide of iron, and the revivification of that oxide after it had become impregnated with the sulphuretted hydrogen contained in the gas, so as to render it capable of being used again. He would call attention by-and-bye to the mode in which these two processes were claimed, but would deal at present with the purifying of gas by means of hydrated oxide of iron.

LORD CHIEF BARON: Is this the same action as that which came before me?

Mr. BOVILL: Yes, my lord; and your lordship will remember some evidence as to how the invention was discovered by Mr. Hills—some experiments that were going on.

LORD CHIEF BARON: Is it the case in which Dr. Taylor appeared, and there was some dicussion about his evidence?

Mr. BOVILL: That is the case, my lord.

LORD CHIEF BARON: Then I know all about it.

Baron BRAMWELL: It really ought to be at once said that the question which then arose does not arise now. Dr. Taylor completed his evidence, and you abandoned the matter.

Mr. BOVILL: I will just state what occurred formerly, because, without reference to the point on which my lord stopped the case on that occasion, it may still be useful to recall my lord's attention to it. The case was opened, and evidence was given on the part of the defendants as to the mode in which Mr. Hills——

LORD CHIEF BARON: I remember it perfectly well. In my opinion, upon the true construction of all the documents before the court, and which it was for the court to construe, the plaintiff was not entitled to a verdict. They may have altered all that for anything I know.

Mr. BOVILL: There is no alteration as regards that evidence.

Baron BRAMWELL: I certainly did not treat this case in a way unfavourable to you.

Mr. BOVILL: Certainly not, my lord. I have no reason to complain of your lordship.

Baron BRAMWELL: But what you are doing now really sets the court against you, because the point was so desperate at the trial that you abandoned it, and it must have been at the very utmost stage of desperation before you would abandon it.

Mr. BOVILL said he was going to mention that the point upon which his lordship eventually stopped the case was with reference to the evidence of Dr. Taylor about some carbonate of iron, and that that particular point did not arise at the last trial. Of course he could not speculate as to what was passing in his lordship's mind, but from the shorthand-writer's notes he judged that some strong evidence was given as to the mode in which Mr. Hills had become acquainted with the matter; for his lordship said—"It is not necessary to go into that upon which there is contradictory evidence," and desired the case to be stopped.

LORD CHIEF BARON: Yes.

Mr. BOVILL said the case came before the court now with the whole of the evidence which was given on the former occasion, with the exception of that which related to the carbonate of iron, and also with some further evidence. He thought that upon written documents alone, independently of parole testimony, but especially with that addition, there was sufficient to entitle the defendants to enter a verdict. The learned counsel having read that part of the plaintiff's specification which relates to the purification of gas by the hydrated oxide of iron, proceeded to say that there were various modes described by Mr. Hills for obtaining such hydrated oxide, and to these he would call attention presently. Hydrated oxide of iron existed in several forms. There was a native hydrate and there was an artificial hydrate. The most ordinary form of hydrated oxide of iron was that of common rust, produced upon the surface of iron by the action of the atmosphere and the absorption by the metal of a portion of the oxygen of the air. The oxide of iron in that form had chemically combined with it a certain portion of water, and was therefore a hydrated oxide. There were other modes of obtaining it—such as by taking sulphate of iron, or muriate of iron, and using magnesia, soda, lime, &c., and precipitating the oxide, which then also imbibed a certain portion of water, and was a hydrated oxide.

LORD CHIEF BARON: It is chemically the same substance in whatever way it may be procured?

Mr. BOVILL said it was; and it was a matter of common knowledge, stated by Berzelius, and well known to all scientific chemists, that hydrated oxide of iron would absorb the sulphur from sulphuretted hydrogen. But in the year 1840, when Mr. Croll took out his patent, it was generally believed by chemists that the anhydrous oxide of iron, or oxide without water, would not purify.

LORD CHIEF BARON: Is there any substance which is anhydrous with which one is as familiar as one is with rust?

Mr. BOVILL: You can get rid of the water which is held in chemical combination in the hydrated oxide by the application of a red heat, and then you have a substance which looks exactly the same.

LORD CHIEF BARON: We all know in various ways the appearance of the common brown rust which is exhibited on the surface of any iron vessel which is not kept in a polished condition, water being allowed to encroach upon it. Can you point out any substance with which one is familiar which is anhydrous?

Mr. BOVILL: Judging by the sight, you cannot tell whether an oxide is hydrated or anhydrous; it has the same appearance.

LORD CHIEF BARON: Is there any common way in which you meet with it, so that you may say, that is an anhydrate?

Mr. BOVILL said the substance sold in the shops as the carbonate of iron had a better appearance than the red rust, and he believed it was very often anhydrous, but he could not mention any familiar substance. There were native oxides—some of the large masses of meteoric iron, for instance—some of which were anhydrous; but as regarded the appearance (and this their lordships would find rather important when he came to the consideration of Mr. Croll's patent) no man by looking at an oxide could tell whether it was the one or the other. The court would very well be able to understand this when it was stated that by the application of a red heat the hydrated became anhydrous oxide.

LORD CHIEF BARON: Heat driving the water away?

Mr. BOVILL said a red heat would drive it away; and it became material in the consideration of this case to remember that any heat short of a red heat would not deprive the oxide of its water. The state of knowledge on this matter was as he had stated in 1840, when Mr. Croll's patent was taken out; but he should mention that from experiments since made it had been discovered, and was now perfectly well known, that not only the hydrated, but also the anhydrous oxides would purify gas from the sulphur. The explanation given, he believed, by Dr. Taylor, and one or two other scientific gentlemen, was that the only difference between the two was a difference of molecular condition. At the same time he was not entitled to say that in 1840 (which was a material date with reference to Mr. Croll's patent) it was understood and known that the anhydrous oxide would take up the sulphur. On the contrary, it must be distinctly taken that in 1840 it was understood and believed by all scientific men that the hydrated would effect the object, and the anhydrous would not. That being so, the first ground upon which it was contended that the plaintiff's patent was bad, was the ground of want of novelty, and that he was not the inventor, but that the subject-matter of this part of his invention had been anticipated by Mr. Croll in 1840, and had been published to the world in the specification of his patent. Mr. Croll was examined at the trial, and it appeared that his invention had not been carried out, and he gave this reason why it had not been:—"The reason why I did not carry out my patent of 1840 for purifying gas with hydrated oxide of iron was, that it was commercially more advantageous to me to use lime; because, in using lime, I had a market for the product. If I used oxide of iron I had not the same advantage; and it was not until the sanitary movement which prohibited the gas manufacturers from discharging their refuse gas liquor into the river that the new mode of purifying by oxide of iron became of essential importance." But it became of importance latterly, and then also Mr. Hills, the plaintiff, brought it into action.

Baron BRAMWELL: I think you might add, as you have mentioned Mr. Croll's evidence, that he very honestly said (if I remember rightly) that he was not aware of the difference between the hydrated oxide and the anhydrous oxide, as to their properties.

Mr. BOVILL: He said so, and I should not be at all surprised if the jury thought he knew nothing about it in consequence.

Baron BRAMWELL: And when he drew his specification, if anybody had asked him which he meant, he would have said both, I suppose.

Mr. BOVILL said he did not know the difference, and an ordinary man, not a scientific chemist, would not know the difference, or would know that there was any. Specimens were produced at the trial, and some chemists put them under the name of carbonate of iron, and said that some had 95 per cent. of oxide in them, and others only 5 per cent; the appearances in all being nearly identical, and Mr. Croll not being a chemist, would not know the difference between the one or the other, and he swore that he did not. All he knew was, that oxide of iron would do what was wanted. He (Mr. Bovill) would now read to the court what it was that Mr. Croll published to the world in 1840.

Baron BRAMWELL: Before you read that, my lord and my brother Watson should bear in mind that the question is whether it shows the use of hydrated oxide for the purification of gas—that is to say, either separately or as one of the materials.

Mr. BOVILL said their lordships would bear in mind that at that time, while ordinary persons would not understand whether oxides were hydrated or anhydrous, chemists knew the difference, and that the former would remove the sulphur from sulphuretted hydrogen, which was one of the objects to be attained in the purification of gas, but they did not think the latter would.

LORD CHIEF BARON: The real fact was, they knew that one would, but what the other would do they did not know.

Mr. BOVILL: They believed that it would not.

LORD CHIEF BARON: The belief of persons on a matter of that sort is nothing when they have had no opportunity of ascertaining.

Mr. BOVILL said chemistry was one of the exact sciences, in which belief was of very little value. Now Mr. Croll, in his specification, described a mode of freeing gas from ammonia which was a totally different matter, and one with which this question had nothing to do. He then added: "It is proper here to state that, after the gas has been submitted to this process (that is with reference to the ammonia), it should have a further purification in order to free it from the remaining portion of sulphuretted hydrogen, which purification is to be effected by means (this was an important part) of the oxides hereinafter described, or in the ordinary way by the use of lime." And at page 4, line 4, their lordships would find the expression—"but before the gas has been deprived of its sulphuretted hydrogen by means of the oxides hereinafter described." At line 16 was this passage, and he read it because it was material:—"The third part of my improvements in the manufacturing of coal gas consists in the application of the black oxide of manganese to remove or free coal gas from sulphuretted hydrogen, which is accomplished in the following manner," &c. Then he said: "The same effect may be produced by the application of the oxide of zinc and the oxides of iron, and treated precisely in the same way as above described." As Mr. Croll said the "oxides of iron" might be used, he (Mr. Bovill) would go back again, and substitute them for the black oxide of manganese. The oxides of iron were things perfectly well known.

Baron BRAMWELL: Do you mean to say that "the oxides" and "all the oxides" are identical expressions?

Mr. BOVILL said Mr. Croll, who knew that the oxides of iron would purify, used the expression "the oxides." He either meant all, or that which everybody knew would take up sulphur. It was impossible to escape from it—he either meant all, and then it would include the hydrated; or, if it was not everything, then it would mean (and every scientific man would understand it there to mean) that which would absorb sulphur.

Baron BRAMWELL: I rather think there was a possibility of hydrated oxide not being included, because there was an anhydrous protoxide, and there was an anhydrous peroxide; therefore, if he was speaking of anhydrous oxides, he might still use the plural.

Mr. BOVILL: "The oxides of iron." Not being a chemist, that would mean the most ordinary oxides. The common known form of oxide of iron was the rust of iron, which was a hydrated oxide.

Baron BRAMWELL: Does the anhydrous exist except as prepared from the hydrated? Is there a native anhydrous oxide?

Mr. BOVILL said he was not quite sure, but he believed that some of the hematites were so. Now, what would any person acquainted with the subject understand by the terms, "the oxides of iron," to be used for the purpose of taking out the sulphuretted hydrogen from gas? It was quite clear that he would take that which he knew would absorb sulphur—viz., the hydrated oxide—because, with the state of knowledge at that time, it was believed that no other kind would do it. So that the expression either meant all the

oxides, and therefore included the hydrated and anhydrous—and in that case Mr. Hills' patent was bad—or it meant that which was scientifically, as well as the most commonly known substance for taking up sulphur from sulphuretted hydrogen; and then it would be equally hydrated oxide.

Lord Chief Baron: Then in page 5, line 30, he makes it part of his invention:—"I claim the purification of coal gas from ammonia by means of chloride and sulphate of manganese and muriate of iron, and sulphuric and muriatic acids; and the purification of gas from sulphuretted hydrogen by means of the oxide of manganese, the oxides of iron, and the oxides of zinc, as hereinbefore mentioned and hereinbefore described." The statement of your case is, that if the patent of the present plaintiff is to stand in its full integrity, then Mr. Croll took out a patent nine years before, notwithstanding which he cannot perform those operations, and consequently great injustice would be done.

Baron Bramwell: Do not suppose that I am against you in any way, because I now interpose to say that you have not stated that which is the difficulty here.

Mr. Bovill said he was now coming to that; he could not have done it until he had stated what he had been doing. In describing the mode of dealing with the oxide of manganese, or as he would now read, "oxides of iron," Mr. Croll said:—"After the gas has been freed from ammonia as above described, it is then to be passed through a vessel similar to those now in use for the purification of coal gas by what is denominated dry lime, and charged in a similar manner with the oxides of iron in powder, moistened with water to about the same consistency. The period required for each charge is to be ascertained and regulated by the same tests as if dry lime were used, and which is well understood; in short, requiring no further alterations except in the materials I employ for the absorption of the sulphuretted hydrogen. This material, after it has ceased to absorb the sulphuretted hydrogen, is to be removed from the purifying vessel and roasted in an oven to expel the sulphur which it then contains." He (Mr. Bovill) was reading this to meet the point which the learned baron had been kind enough to notice, and their lordships would take notice of this point as it was one which the plaintiff made against him. "After this material has become thoroughly red in the oven, I have found from two to three hours further time to be sufficient to accomplish this object, taking care that whilst it is being roasted it be well stirred about in the oven. After this operation is complete, the material is fit again to be employed by being placed in the purifier moistened with water as in the first instance." Now what was said was this: Looking to that part of the specification in which it was said that the material might be roasted, and thus expel the sulphur which had been imbibed; and then, looking to the expression "after it has become thoroughly red in the oven," it was shown that the material which had been once used was to be brought to a red heat, and that in bringing it to a red heat the water was necessarily driven off from the hydrated oxide, and a material was left which was anhydrous; and it was therefore argued that Mr. Croll intended to show the use of an anhydrous, and not a hydrated oxide. The answer to that argument at once was, that whatever Mr. Croll might do afterwards, he did not know, scientifically, the difference between the two oxides. He saw a substance which was oxide of iron; he used it; it was hydrated oxide that he used. That would be the explanation, and it might be true.

Lord Chief Baron: Upon this point you are entitled to a rule.

Baron Bramwell: Clearly; I should say so. Mr. Croll might have been very much surprised when he exposed his hydrated oxide to a red heat, and then found that it would not act a second time because it had become anhydrous, if the fact had been so; but it would not have made him less the inventor of the use of the hydrated as well as the other oxide.

Mr. Bovill said there was this also, that they had Mr. Croll's parole evidence as to what he did. What he did was this: he used hydrated oxide of iron; he purified great quantities of gas with it; and then, in restoring it to its state for use again, he first of all roasted it in an oven, and brought it to a red heat; but afterwards, and long before the plaintiff's patent, he did not roast it to a red heat, and therefore he had done it both ways. In the first instance he used hydrated oxide of iron, and after it had been used, he employed it, both hydrated and anhydrous.

Baron Bramwell: It is right it should be borne in mind that, according to recent discovery, even if he had roasted it to a red heat to drive off the sulphur, and had thus made it anhydrous, it would have answered again. The argument on the other side is this: that it must have been an anhydrous oxide, because the context shows that in the second process it could not have been hydrated. If that reasoning is to a certain extent correct, it must be borne in mind that the fact is otherwise in a sense, because the witnesses proved that you might roast the manganese of commerce to a red heat and not anhydrate it; and all that Mr. Croll says is, "Treat the oxide of iron in the same way." He might have been mistaken in supposing that you could do so—*i.e.*, that you could roast it to a red heat and not anhydrate it—*quoad* iron; the legitimate inference is, if their reasoning is correct, that Mr. Croll was mistaken.

Mr. Bovill: However they might be right in the subsequent process, there is nothing there to indicate that it was to be anhydrous when he first used it.

Lord Chief Baron: I think, if a man takes out a patent for a process, and publishes a mode of doing it, we cannot allow any number of chemists to come and say, "We have read the specification, and with reference to the state of knowledge at that time we are quite certain that the patentee did not mean this, but meant something else; and therefore another man seeking a patent for exactly the same thing at a recent date, and in a more enlightened state of chemistry, is entitled to his patent." If Mr. Croll's patent is a good patent, the plaintiff's is a bad one; because the plaintiff's patent, if a good one, would prevent Mr. Croll doing his own work.

Mr. Bovill: Quite so, my lord.

Lord Chief Baron: Take a rule to show cause on this point.

Baron Bramwell: I think, in order to prevent any mistake, the court ought to know that the plaintiff says, "My patent is for a combination—there is first purification, and then revivification; consequently, if this part of my invention is not new, still my invention as a whole is new."

Mr. Bovill referred to the terms of the plaintiff's patent as to the purification of gas by the use of oxides alone, or in combination with some porous material, and urged that the process of revivification was claimed by him as a second and distinct matter.

Baron Bramwell: In order to save expense to the parties, I put all sorts of questions to the jury upon this matter, and they found every one of them against you. So far as the question was for them to decide, they said that neither Mr. Croll's specification nor Mr. Croll's practice, nor Mr. Croll's practice and specification together, prevented the plaintiff's invention from being the subject of a good patent.

Mr. Bovill: That is the reason, my lord, for my moving for a new trial. I also propose to move that the verdict is against the evidence.

Baron Watson: The court is to construe the terms of the specification.

Baron Bramwell: I felt bound so to leave it, upon the ground of the extrinsic matters required to be proved—that hydrated oxide alone was supposed to be capable of purifying, and anhydrous would not; but now it was known that it would.

Mr. Bovill said he had no complaint to make. His lordship reserved all the points to the defendants, but thought it more convenient that the jury should give their view of it. He contended that both upon the documentary and the parole testimony, the verdict was against evidence upon the points of the different specifications.

Baron Bramwell: After all, it comes to the true construction of this specification. It is quite clear that the court is absolutely to construe this document.

Lord Chief Baron said there was a very recent case in the House of Lords (*Bush v. Fox*) where that point was distinctly decided, and it was the only point that was decided. If he remembered rightly, there was, in that case, a comparison between Lord Cochrane's invention and that of the plaintiff; and in comparing the two it appeared to him that they were identical, and therefore he nonsuited the plaintiff. It then went up to the House of Lords upon that, and the Lord Chancellor (Cranworth) and all the law lords and the judges who were there at the time, agreed that it was for the court to decide upon two conflicting patents, where the matter was intelligible.

Baron Watson said in the case of Meeson's patent it was laid down most distinctly by Baron Parke, that "the construction of all instruments belongs to the court alone, whose duty it is to construe all instruments as soon as the true meaning of the words in which they are couched, &c., has been ascertained by the jury."

Mr. Bovill said in the case of *Booth v. Kennard*, the latest in this court, the same rule was laid down. He passed now from Mr. Croll's patent, mentioning that he moved not only upon that patent itself, but upon the parole evidence of Mr. Croll, and submitting that if the question was for the court, the defendant was entitled to the verdict, and if it was for the jury, the jury had found, either upon the evidence or upon the patent, wrongly. He passed now to the patent obtained by Mr. Laming in 1847, and he believed that he should be able to show very clearly that precisely the same thing in substance was to be found there. Before reading any part of this specification he would tell their lordships how the evidence stood uncontradicted, as given by the plaintiff's witnesses in answer to Baron Bramwell's questions. If muriate of iron, or some other metal, and lime were mixed together, two substances would be produced which would be in mechanical combination—one was the chloride of calcium, and the other the hydrated oxide of iron.

Baron Bramwell: It is carbonate of iron in the first instance, while the wet remains about it, but the carbonate of iron has such an affinity for oxygen, that as soon as you expose it to the air and dry it, the carbonic acid flies off and it becomes oxidized.

Mr. Bovill said there was this peculiarity about Mr. Laming's process. Mr. Croll had the hydrated oxide of iron, so Mr. Laming took out a patent for using chloride of calcium, and did not say much about oxides of iron. But, in answer to his lordship's question, one of the witnesses stated, that when it was desired to produce chloride of calcium by muriate of iron and lime, carbonate of iron was first produced, and that by exposure to the air the carbonic acid was got rid of. The same quantities of muriate of iron and lime would be employed, and any man using this mixture for the purification of gas would be using the two substances in mechanical combination—chloride of calcium and carbonate, which afterwards became hydrated oxide of iron. The importance of this was that chloride of calcium was of no avail in taking up sulphuretted hydrogen, but was of great service in removing the ammonia, and there was no contradiction in the evidence upon this point.

Baron Bramwell: Not only so, but if by any chance you got the two things separate, the best thing you could do would be to combine them.

Mr. Bovill: Just so; because, by passing gas through, in one operation you got rid both of the ammonia and the sulphuretted hydrogen. Now, seeing that Mr. Croll in 1840 had patented the use of oxide of iron for the purpose of getting rid of the sulphuretted hydrogen, when Mr. Laming came he did not profess to do so, but he said, "I will patent the chloride of calcium for getting rid of the ammonia," and accordingly he did so; but, in explaining to the world the mode in which he used the chloride of calcium, he published in his patent the way in which he purified gas by means of hydrated oxide of iron. It was not a part of the claim in his patent, but the defendants' case upon this was, that Laming showed the very mode, which would be perfectly intelligible to all scientific men, of purifying gas by the very means which Mr. Hills afterwards patented. He would now call attention to Laming's specification itself.

Baron Bramwell: Mr. Laming may be taken to say this: "I claim the use of chloride of calcium; I prepare it in such a way that it will combine with oxide of iron. I do not object to that; on the contrary, I think it is a useful addition; but I do not claim it. I claim the chloride of calcium only."

Mr. Bovill: He does not claim it in his patent as an invention of the use of oxides, but he shows the oxides of iron, and says they are very useful things to get rid of the sulphuretted hydrogen.

Lord Chief Baron: I have in my copy of Laming's specification an indication that I thought the passage fatal to the plaintiff's claim; and I have now a distinct recollection that I thought it so, but did not say so, as it became unnecessary. I thought it entirely destructive of the plaintiff's patent, and that was one of the reasons (there were several) why I thought that the cause had come to an end. I see there is a very strong indication in the margin that, in my opinion, that passage was quite fatal to the claim on the part of the present plaintiff to do that which Mr. Laming had done before.

Mr. Bovill: Then your lordship proceeded to stop the case upon the ground of the carbonate of iron spoken of in Dr. Taylor's evidence, and you refused to let it be reopened.

Lord Chief Baron: I suppose the jury have not found the fact; but I thought it very distinctly proved before me that the invention was really not the plaintiff's.

Baron Bramwell said there was a point which raised a fair question (to say the least of it), whether this matter was really so clear as at first sight it appeared. Mr. Laming did not claim the use of the hydrated oxide of iron, but he used it because it was a useful thing. The plaintiff claimed the invention and use of the oxide, which he prepared in such a way that there was a compound of lime with it; and it was proved, though the plaintiff did not say it, that the best thing he could do was to use these two things together. But it must be borne in mind that Laming used a muriate of iron which produced a chloride of calcium, and the plaintiff used a sulphate of iron which produced a sulphate of lime. The sulphate of lime had, to a certain extent, the same operation as the chloride of calcium, and

the plaintiff's witnesses swore that the difference between them was not a colourable one, but that the chloride of calcium was a deliquescent substance, and consequently that it got slimy after being prepared, and the whole could not be used; whereas the sulphate of lime was not deliquescent, its porosity would continue, and it could all be used, and that that was what made the plaintiff's preparation preferable to Mr. Laming's. He (Baron Bramwell) left the question to the jury what was the difference between a variety of the same invention and a new invention, and what was a new invention, and the jury found everything against the defendants.

Mr. Bovill said one could not be surprised at the result in a trial like this, after hearing the opening on the part of Mr. Hills. Mr. Hills was introduced as the most enlightened character of the day, and as being worthy of admiration; and after the jury had listened to a long speech from his learned friend, the Attorney-General, and to the evidence on the part of the plaintiff for some days, all declaring that this was the newest invention which could be, and that nobody else had produced it before, or made it of any avail, the minds of the jury were so impressed that they apparently did not treat any of the questions raised for the defendants—he would not say as worthy of their consideration, but as of that importance which probably their lordships might think they deserved. However, as regarded Laming's process and the deliquescent substance referred to, the moment the plaintiff's witnesses attempted to introduce that distinction they were met in this way:—Mr. Hills describes in one place the use of sulphate of iron and magnesia, which would produce precisely the same deliquescent substance as the chloride of calcium in the other case. Therefore the attempted distinction entirely failed upon the face of the patents themselves.

Baron Bramwell: I do not think you can say, upon a comparison of the two patents, that they are identical; because the one uses a muriate, and the other a sulphate.

Mr. Bovill said, with regard to that part which he had mentioned, the thing was identical; and though the one used muriate, and the other sulphate, the effect, so far as the oxide of iron was concerned, was precisely the same. If Mr. Laming, in his patent, had pointed out that the oxides or carbonates which resulted in the preparation of chloride of calcium were useful, and if he claimed the combination of the chloride of calcium and a metallic oxide, and the application of such mixture to the purification of coal gas, how could Mr. Hills come afterwards and say—"I claim the oxide which is produced, and I claim it either alone or mixed with other known purifying materials?" The thing was utterly impossible. Mr. Laming also claimed the use of carbonate of iron for purifying gas; for which purpose, he said, "I damp it and dispose it, mixed or unmixed with sawdust or other matters, in the course of the gas, &c." Now, as respected the carbonate of iron, Mr. Hills in another part of his patent described the production of hydrated oxide—by means, amongst other things, of soda. For the plaintiff it was contended that "soda" there meant carbonate of soda in the ordinary sense; and if so, the result would be a carbonate of iron precisely as Mr. Laming described. But to go back for a moment, he (Mr. Bovill) had omitted to mention that Mr. Hills said the oxides of iron might be conveniently prepared by decomposing sulphate or muriate of iron with hydro-sulphuret of ammonia, or with lime, magnesia, potash, or soda. Therefore, as regarded the description of the material, the two things were identical; only the one claimed the hydrated oxide of iron as the principal matter, and the other the chloride of calcium. The moment that this was explained to their lordships, and the fact stated that Mr. Laming had previously said, "the oxides or carbonates which result are useful for purification," they would see that there was no pretence for Mr. Hills claiming a patent for it. At the trial, evidence was given with reference to the carbonates which appeared to amount to this:—If you use carbonate of soda and chloride of magnesia, or any carbonate in connexion with sulphate of iron, you get necessarily a carbonate of iron, but which carbonate of iron cannot be preserved in a dry state as a carbonate, because by its exposure to the air it loses its carbonic character; therefore Mr. Laming might well say, "the oxides or carbonates which result," because it was a carbonate when not exposed to the air, and became an oxide when such exposure took place; and he describes a mode of mixing it with sawdust and other things, and by such a mixture, and consequent exposure, it became pretty nearly a pure oxide. Again, it was material to observe that in the very process which the plaintiff described for producing an oxide of iron, if he used carbonate of soda he produced a strict carbonate precisely as the other did. There were also other points of resemblance in the patents, such as the employment by both of this material "damped and mixed with sawdust," and the obtaining by Mr. Laming of his carbonate by throwing down from ammoniacal or gas liquor obtained in making coal gas, and previously distilled or not, the sulphur which it contained, and having drawn off the clear liquid precipitating the carbonic acid, and the employment by Mr. Hills of hydro-sulphuret of iron.

Baron Bramwell: I should say that upon this matter there is very good ground for stating that there is an identity between Mr. Laming's and the plaintiff's specification. The case was met on the other side by the statement that the plaintiff's patent was neither better nor worse, because he tells you how he prepares his hydrated oxide of iron. They say he claims the use of hydrated oxide of iron, and his patent ought to be read as such only, and his statement of how he prepares it is immaterial. If that is so, your proof of identity must depend upon your showing that Laming forestalled the plaintiff in his invention.

Mr. Bovill said that was the way in which he used it, and he was pointing out these similarities merely as ancillary.

Baron Bramwell: I should think on that also, as a matter of law, you are fairly entitled to a rule. It should be discussed, to say the least of it.

Mr. Bovill said the bearing of it was this, that Mr. Laming said he used ammoniacal gas liquor and precipitated, and it was found that the only precipitant was hydro-sulphuret of iron, the thing which in his patent Mr. Hills proposed to use. It was not necessary that he should trouble their lordships with other points of similarity, as the shorthand-writer's notes of the last trial had been printed; but he would consider that he had stated all the grounds which he stated at the trial. The next point was that the plaintiff had specified for something for which he did not take out his patent. No doubt as to this matter the Lord Chief Baron would remember what took place at the first trial. Mr. Hills took out his patent for "an improved mode of compressing peat for making fuel, and of manufacturing gas and obtaining certain substances applicable to purifying the same;" and the patent was dated Nov. 28, 1849, the specification being filed six months afterwards. In compliance with the rules laid down by the Attorney-General, he deposited with that officer of the Crown, on taking out his patent, a certain paper which contained a variety of matters under different heads. Their lordships would find that the head under which he now professed to claim this purification of gas and the renovation of the materials, was not to be found in that paper. First of all, he said that his invention was for compressing peat between inclined planes; secondly, for carbonizing coal in retorts and furnaces.

Lord Chief Baron: "An improved mode of [manufacturing gas" may mean anything. It was not unreasonable that the Attorney-General should say, "As your title is so general, give me some intimation that I may know what it is you intend to include in your patent."

Baron Bramwell: Assuming that he meant it to apply to this, you say that he is not entitled to specify for a different thing from that which he has shown in this paper.

Mr. Bovill: A little more than that. We say: "Supposing you have invented it, your patent was not taken out for that, but for something else, and you chose to put it in afterwards."

Baron Bramwell: I do not think I left any question to the jury on that point. You put it as a dry matter of law, assuming he did invent it, and took out his patent for it, yet as in the preliminary note he did not indicate anything of the kind, the specification is not warranted.

Mr. Bovill submitted that not only as matter of law upon the construction of the paper, but also as matter of fact, the jury were not warranted in finding it upon the evidence. There was formerly a very objectionable system of what were called open patents.

Lord Chief Baron said when he was Attorney-General there was one manufacturing house that regularly took out a patent every year for an improvement in the manufacture of a certain article, and then whenever anything turned up they had always a patent ready to specify. Their object in the title of their patent was to make it so wide that nobody should guess what it was. There was a case decided before Lord Ellenborough, where the title of a patent, which was for a new lamp, was "For a new mode of lighting towns." The title of the patent for the atmospheric railway was, "An improvement in valves," which was suggested by a very eminent person in the patent law, undoubtedly for the purpose of keeping the world in ignorance of the real nature of the invention.

Baron Bramwell said he could not report that he was dissatisfied with the finding of the jury upon this point. Believing it to be matter of law on which he had to decide, he did not originally leave the question to them; but having done so at last, they obviously answered it in the affirmative, because they had found the plaintiff to be the inventor. The paper stated that the patent was for "absorbing sulphuretted hydrogen and other gases into porous bodies, and removing them again either by heat, &c., or taking off the atmospheric pressure." Now, he did use porous bodies, and he did take off the atmospheric pressure; and the comment made at the trial was, that any one would suppose the effective agency was the porosity of the body, whereas that was only a mode of applying the hydrated oxide. Any one would suppose that the effective agency in the renovation was the removal of the atmospheric pressure, whereas that was only taken off to make the air circulate, and so revivify; and the comment made upon it was, that a person specifying this patent would say, "I use hydrated oxide of iron, and expose it to the air;" and therefore this paper showed that he had not invented that process at the time. The jury found against the defendants, and he (Baron Bramwell) thought it was a matter of indifference. He thought that if the plaintiff had applied for a patent, the title of which comprehended this invention, and if it appeared that at that time he had invented it, and did afterwards specify for it, the fact of his having untruly put in a note which did not describe his invention did not vitiate his patent. The way in which that note was of importance was to show that if he had invented it, he had not applied for his patent on that score, and that consequently Her Majesty had not granted him a patent upon that ground. That was the opinion which, in point of law, he had.

Mr. Bovill said there was no doubt it was most material evidence upon the other point whether he was the inventor.

Lord Chief Baron thought there was a good deal of evidence upon that which was clearly for the jury. There might be some doubt whether the effect of the paper delivered to the Attorney-General ought to be to cut down the Queen's grant; that if the Queen's grant embraced this in language, the court were to cut down its effects upon a sort of parole evidence of what passed with the Attorney-General. It might be a ground for revoking the grant, but he did not think it was for cutting down the effect of it.

Mr. Bovill said the way in which it became material was, that an issue was raised upon it on the record, and there was evidence at the trial that Hills had been engaged in attempting to purify gas by means of sawdust and water trickling through it.

Lord Chief Baron said he doubted whether, if the language of the Queen's grant was so general as to include this, the court could say it did not include it because the deposit-paper did not.

Mr. Bovill submitted that it might have been made a ground of demurring to the sixth plea, which was, "That the invention described in the specification is another and a different invention from that for which the letters patent were granted;" but it had not been demurred to.

Lord Chief Baron said he had stated this because he remembered a decision in the Queen's Bench in a case where it was perfectly clear and admitted that a man had specified what was not in his mind at the time. The court held that the patent was good and the specification was good; and it would be impossible to uphold that decision of the court and at the same time give effect to Mr. Bovill's objection. The decision was, that not only was a man entitled to put in any new matter relative to the same subject which occurred to him after the letters patent were sealed, but Mr. Justice Bayley laid it down that it was his duty to do so. He (the Chief Baron) doubted whether the six months were given for the purpose of the patentee making new inventions and including them in his patent. They were possibly given to enable him to perfect his experiments and take care to make his specification what it ought to be. Mr. Justice Bayley, in the case referred to, did not go so far as to say that the patent was void if the patentee did not put in what he had subsequently discovered, but he seemed to intimate that he would be wrong in keeping back some other invention for the purpose of afterwards taking out a fresh patent for it. If the Crown were deceived in reference to the subject-matter of the patent, proceedings by way of *scire facias* to make it void might be taken.

Mr. Bovill said, as that was the view taken by the court, he would not press the point.

Baron Bramwell said the learned counsel's objection was upon the face of the document, and the jury having heard all the facts, were against him.

Baron Watson said the mode of looking at this question was to take the deposit-paper and the specification together, and see whether one was really different to the other, and not to ask what was the man doing or attempting to do at the time.

Mr. Bovill said the deposit-paper stated the invention to be for absorbing sulphuretted hydrogen and other gases into porous bodies, and removing them again either by heat or taking off the atmospheric pressure. Now, although the first part of this language was applicable to the absorbing of

gas into sawdust mixed with water, yet, for the purpose of renovation, the plaintiff did not remove the gases by heat or removal of the air. He simply exposed his hydrated oxide of iron, when it had been used, to the action of the atmosphere; and the air performed its duty and left the oxide free. There was no such thing in his patent as removing gases from porous bodies by heat or atmospheric pressure, and, on the other hand, there was not a single syllable in his deposit-paper which referred to the revivifying of oxide of iron by exposure to the air.

Baron BRAMWELL: How does he revive the porous material? He exposes it to the air. How does he do it? He removes the air from the top or bottom, I forget which, and consequently, the other part being exposed to atmospheric pressure, there is a current of air through it.

Mr. BOVILL submitted that it was not quite so. Plaintiff said it was to be done by exposure to the air, and that you might produce a current of air through it or not.

Baron BRAMWELL: He does expose it to the air. Instead of taking the material from the vessel and spreading it out to the air, he leaves it in the vessel and causes air to go through it.

Mr. BOVILL: He may do it, but it will not do, for this reason—that is sending air through the body, but it is not removing the gas out of the porous body.

Baron BRAMWELL: It removes the sulphuretted hydrogen.

Mr. BOVILL: It is not a gas he is removing; it is solid sulphur—a different thing altogether.

Baron BRAMWELL: I suppose the sulphuretted hydrogen has been reduced to its constituents—*i. e.*, the hydrogen has gone into the air. This is a special demurrer.

Mr. BOVILL submitted that it was not, and that there was nothing at all in the paper to warrant the specification, because it did not contain a single syllable about removing gas from a porous body, though there was a totally different matter—viz., the renovation by exposure to the air to get rid of the sulphur.

The LORD CHIEF BARON said he was not disposed to grant a rule. He thought the subject could not avail himself of this point, whatever might be done by the Attorney-General on the part of the Crown. The validity of the patent itself was made to rest upon the specification being enrolled within six months; and he did not think that if the patent was within the terms, the court could cut down the Queen's grant. Were they to send that patent to a jury, to say whether it was to be affected by certain correspondence which had passed between the Attorney-General and the patentee? That would be so repugnant to every legal notion as to how the Queen's grant of patent was to be construed, that he would be sorry that there should be any doubt upon the subject.

Baron BRAMWELL thought there should be no rule on this point. It must be taken that the plaintiff made a certain invention; that he applied for and obtained a patent for it; and, for the moment, it might be assumed that his deposit-paper did not express the matter for which he applied. Even upon that state of things, it appeared to him that his patent was a perfectly good one. He had made a mistake in stating what he wanted before; but in reality he did want the patent, and had obtained it for his invention, because he meant to have it for that purpose, and the title of his patent comprehended it. If, indeed, the jury had found that when he applied for his patent he had not invented the matter, or that, in truth, he did not apply for it, a very different question might have been raised; but the jury must be taken to have found that, though he had inaccurately or insufficiently described what he was looking for, he in reality obtained a patent for this invention. That being so, the insufficiency of the note was of no importance upon the present occasion, though it might be a ground for repealing the letters patent.

Baron WATSON was of the same opinion. The line of defence, based upon the memorandum delivered to the Attorney-General, was necessarily quite modern. There had not been above one or two cases on the subject, and it appeared to him a very odd sort of defence. He did not quite concur in, and should require more time to consider, the view expressed by the Lord Chief Baron as to specifying for something which was different to the memorandum laid before the Attorney-General, but he did not see in what manner it was to be taken advantage of. That, however, was what was meant by this plea; but it had not been proved. It was possible, by making very fine distinctions, to say this or the other was not involved in it; still it was clear that the plaintiff applied for a patent for some such thing, though he might not have perfected it so far as he afterwards had when he made the specification. Reserving to himself to say hereafter in what shape the other state of things might be taken advantage of, he thought that in any view of this case the defendants were not entitled to a rule.

The LORD CHIEF BARON said that, though the Queen's grant of patent was matter of record, evidence of what it meant could not be given as upon a record in an action for money had and received. In the case of a judgment, the subject of demand was only known by parole testimony; but this could not be given in the case of a grant from the Crown. There were but two ways of doing it—either by the decision of the court, or by the verdict of a jury. Referring it to a jury to say what the Queen meant by a grant, seemed to him to be really contrary to the first principles of our constitution. The court unanimously refused the rule on this point.

Mr. BOVILL said the next point was that the specification was insufficient for not specifying which of the hydrated oxides would answer the purpose. Upon this part of the case the evidence was very distinct, that hydrated oxides of iron were of two kinds, natural and artificial; that some of the natural hydrates would not purify, as they would not absorb sulphur; and that it was only the artificial that would do it. The plaintiff, however, claimed both natural and artificial, and on that ground his specification was bad, inasmuch as it included those native hydrates which would not purify; and he had not distinguished them, so that the public would be driven to experiments to determine which would answer the purpose. The learned counsel quoted in support of his view the decision of the court in *Stevens v. Keating*, in which it was held that the specification was defective as it claimed all alkalies and acids for a certain purpose, and it was proved that some would not answer.

Baron BRAMWELL said upon this point the learned counsel was entitled to a rule, unless the answer to his argument was that the plaintiff always said "the hydrated or precipitated," treating them always as equivalent expressions with an *alias*.

Mr. BOVILL said, if so, the plaintiff was wrong upon the construction of the patent. If the defendants were to use a native hydrate which would absorb sulphur, would Mr. Hills stand up in the court and say that his patent was confined to the artificial hydrates? He would say, "I have described hydrated or precipitated oxides, and why am I to be limited to precipitates and artificial hydrates only?" and their lordships would very justly say, that if this were a good patent, nobody could use the natural hydrates without infringing it.

LORD CHIEF BARON: Take a rule upon that point.

Mr. BOVILL said the next point was, that the use of hydrated oxide of iron to absorb sulphuretted hydrogen was the application of a perfectly known matter for a known purpose, and therefore the mere application of it in connexion with the purifying of gas was not the subject-matter of a patent.

Baron WATSON: Does the patent claim merely the application? The patentee does not state that these things were well known before, does he?

Mr. BOVILL: No, my lord; he treats them as new.

LORD CHIEF BARON: Did the jury find that the substance was never known to absorb sulphur before?

Baron BRAMWELL: It was a conceded fact. It was a matter of common scientific knowledge that hydrated oxide of iron had an affinity for sulphuretted hydrogen.

Mr. BOVILL said there had recently been before the Court of Queen's Bench a case very similar to this, and which was tried at Hertford. It was a case of the purification of sewerage water by means of lime. It was well known that lime would purify fœtid substances in water, and would precipitate the contents. Nobody had applied it to sewerage, but a Mr. Higgs took out a patent for deodorizing sewerage water by means of hydrate of lime. The Court of Queen's Bench considered that the patent could not be supported for that purpose, but by the terms it might be supported as a patent for purifying manure, and for the manure produced by the process; and that then if a man produced manure, it might be an infringement of the patent.

LORD CHIEF BARON: You may take a rule also upon that point.

Mr. BOVILL said the next point was somewhat similar, and referred to the renovation of the hydrated oxide of iron after it had become charged with sulphur by exposure to the air, which was perfectly well known before the date of this patent. There was not here even the application to gas, and therefore this point was stronger than the last.

Baron BRAMWELL: If that be so, upon the same principle that you got your rule on the other point you ought to have it upon this.

Mr. BOVILL said the next point was one taken by the Lord Chief Baron upon the first trial—viz., that the plaintiff's specification as amended was not within the title of the patent as amended. The title as amended was, "An improved mode of manufacturing gas," whereas the specification in the first place was for "Improvements in the purification of gas," which was to be effected by the use of hydrated oxide, either mixed or unmixed with other things. No doubt that was a matter connected with the manufacture of gas, and possibly was an improvement in it; but the next claim, which was for renovating the material so employed, could not be said to be an improvement in manufacturing gas.

LORD CHIEF BARON: Take a rule to show cause on that point.

Mr. BOVILL said the next point was that the amendment and disclaimer were not authorized by the Act, the patent being altered and extended by such disclaimer. The learned counsel read the remarks of the Chief Baron on this point, and after some conversation thereon—

The LORD CHIEF BARON said: I think we ought in every case to give as large a construction to the title of a patent as it is capable of receiving; and it is impossible to say that this is not an improvement in the mode of making gas. The patentee says: "My improvement is, that the gas is purified; except that part of the operation, I disclaim; and I have the additional advantage that I subject the materials that I use for the purification to a process which enables them to purify over again." It is impossible to say that that is not an improvement in the manufacture of gas.

Mr. BOVILL said his next point was a very similar one to that upon which the court last granted a rule—viz., that, having disclaimed part of the title (as to the substances), the patentee could not claim the renovation. That was pretty much another mode of stating the same point, and therefore he would put it in that way. He did not know whether at the trial the objection was taken that the title of the patent, "for the manufacture of gas," was too large.

LORD CHIEF BARON: I do not know that we can entertain that.

Mr. BOVILL said the only other point upon which he had to move was, that the verdict was against the evidence upon the several points left to the jury, except upon the point already disposed of by the court—that the plaintiff had taken out his patent and lodged his deposit-paper for a different invention to that which he afterwards specified. The learned counsel went through portions of the evidence to show the leading features of that part of the case which bore upon the question of the plaintiff not being the first inventor.

Baron BRAMWELL: You have positive proof that Mr. Laming had invented it before. You have Mr. Hills' positive oath that he did not know of it, and that he invented it himself. You have the strongest proof that Mr. Hills was making experiments where Mr. Laming was making experiments, and you have the strongest proof that he knew it. But he says that he did not know it, and was only there twice. You have the evidence of Mr. Evans that what he told Mr. Thompson he told Mr. Hills. On the other hand you have a most respectable witness swearing that a long time ago the plaintiff had discovered these things, or was in possession of the secret, and that experiments upon it were made in 1848. Then you have the corroboration which you urge, that Mr. Hills' deposit-paper did not indicate that he was experimenting upon the thing for which he specified, because it speaks of porous material only; and you have the fact, also, that if Mr. Hills did invent it, he let thirteen months go by before he patented it.

Mr. BOVILL: And, though he had made this very valuable discovery, we find him in 1849 trying experiments with sawdust.

Baron BRAMWELL: The explanation was, that he had not perfected his invention.

Mr. BOVILL thought that that would not serve him, as in 1849 he was trying experiments with sawdust and water, when, according to his own statement, he had at that time the most perfect thing ever invented.

Baron BRAMWELL: You ought not to say that, because a man might say, "I cannot tell what the effect may be." I left this case to the jury, not unfavourably, I think, to you, and they found against you. I cannot, technically speaking, say that I am dissatisfied with the verdict; *i.e.*, I cannot report that I am satisfied they were wrong.

Mr. BOVILL said there were strong corroborations and confirmations of the view which he had taken, that the plaintiff was not the first inventor, but that he had derived his knowledge of the purifying process from the previous specifications of Croll and Laming, and that the idea of the renovation he got from seeing the stuff, which it was admitted he or his brother must have seen, when Laming's experiments were going on. In conclusion, he submitted that the whole of this matter was very much connected with the other specifications, and that the whole subject should be considered together, or that at least the court should afford an opportunity of discussing the effect of the whole of the evidence in connexion with the other matters in the case.

The LORD CHIEF BARON: Take a rule to show cause on this point also.

SATURDAY, NOV. 20.

On the case being called on for argument,

Mr. GROVE, on the part of the plaintiff, made an application to the court to allow it to stand over until next term, as the Attorney-General, who appeared for the plaintiff, would be incessantly occupied during the present sittings. They had had a consultation together, but he (Mr. Grove) was not as yet instructed.

Baron BRAMWELL said it was a case which, for his own part, he should like the Lord Chief Baron to hear. He was very much inclined to think that it should stand over till next term. It was desirable that the day fixed on for the hearing should be kept to, as he (Baron Bramwell) supposed he should be obliged to be there.

Adjourned accordingly.

LAMBETH COUNTY COURT.

WEDNESDAY, NOV. 10.

(*Before* J. PITT TAYLOR, *Esq., Judge.*)

SPRATT *v.* THE SOUTH METROPOLITAN GAS COMPANY.

Mr. GAY appeared as solicitor for plaintiff, and Mr. ROBINSON as counsel for defendants.

Mr. GAY stated that plaintiff kept a public-house called the Victoria, in Hen and Chicken Lane, Walworth Common, and having intimated his desire to be supplied with gas by the company, he was refused, unless he previously paid a deposit of £2, which he declined to do, and consequently his house had remained unlighted with gas, for which he sought damages. The Act under which the company were incorporated, 5 Vic., cap. 79, gave no authority for making the demand of £2, or any other sum as deposit.

Mr. ROBINSON submitted that there was nothing in the company's Act by which they were compelled to lay on the gas. In the neighbourhood where plaintiff had resided there had been considerable difficulty in obtaining payment for gas, and from that cause the gas had been cut off from plaintiff's house before he became the occupant. It would be hard upon the company if every inhabitant could come and make a demand to lay the gas on, and thus put the company to expense, as well as placing them in difficulty as to obtaining payment.

Mr. GAY: The plaintiff had offered to pay 2s. 6d. as the expense of laying on.

Mr. ROBINSON: I am instructed that this was not done until after plaintiff had been advised so to do by the Gas Consumers' Protection Society, which he had joined.

His HONOUR then read several portions of the Act, dwelling particularly upon the preamble in which the company undertook to supply gas to the various south metropolitan parishes, including that of St. Mary, Newington (in which plaintiff's house is situate), and also showing that they specifically agreed to supply all shops, taverns, &c.

Mr. GAY called attention to the 90th section.

Mr. ROBINSON said the company were merely asking for a quarter in advance.

His HONOUR: There is not the slightest doubt in the world that, according to the Act, they are bound to supply any inhabitants in their district who may choose to apply. The question is, whether they can make them pay beforehand, or at what time afterwards. By the common law of the land, if parties obtained certain powers and privileges under an Act of Parliament, they were bound to let the public have the full benefit of that Act. If a railway company were by that Act authorized to take his lands, they had obtained that power by a representation to the Legislature that they intended to do something for the benefit of the public, and, consequently, every person had a right to travel by such railway on tendering the legal fare. By the Act a contract existed between the company and the public generally, for the Legislature granted certain rights and privileges, and the company undertake to perform what they stated on their application for an Act of Parliament. The company got the right to supply the light, and then undertook to supply all the parishes, and were bound to supply all taverns, shops, houses, and streets when required.

Mr. ROBINSON: There is a difference as regards railways, for they are common carriers.

His HONOUR: This is the contract: the company came to the Legislature for an Act, and in order to obtain it, undertook to do certain things for the benefit of the public, and if they failed it would be tantamount to a fraud upon the Legislature.

Mr. ROBINSON: But suppose there were two gas companies?

His HONOUR: That would not affect the question. Certain parties entered into a partnership for public purposes, and the result was what he would term a legislative contract, which was perfectly binding upon the company.

Mr. ROBINSON: But supposing the company lay the gas on, parties might only take it for a week, and refuse to pay more. He would submit that the company had power to make contracts upon certain conditions.

His HONOUR thought it was not reasonable the company should demand payment of a quarter in advance. They might impose reasonable terms, and might call for a reasonable guarantee. He would suggest that the company should have the question disposed of in a superior court.

Mr. GAY: But my client is too poor a man to go there.

His HONOUR said the company had no right to impose payment of any sum of money for laying on gas, but were bound to enter into a contract to supply gas to those in their district who required it. He would give judgment for plaintiff Damages, £2 and costs.

IN THE ARBITRATION OF THE GREAT CENTRAL GAS CONSUMERS' COMPANY AND MR. ALEXANDER ANGUS CROLL.

(*Continued from page* 635.)

NINETEENTH DAY—*continued.*

Dr. *Leeson* recalled, and examined by Mr. LLOYD.

The three gentlemen who were appointed by the company with myself to test the gas did institute comparisons between the darkened and the light rooms, and with the same effect as Mr. Warington states. We also made a great many experiments to ascertain the relative effects of placing the photometer in different parts of the room, and the result we came to was, that in a moderate-sized room the effect of the whole was within the errors of observation—that it did not make a quarter of a candle difference.

Mr. BARLOW: What sized room do you mean?

Witness: The room that the company had was, I should think, about 16 or 18 feet long, and about 14 or 15 wide, and the photometer was placed in various positions. I also made similar experiments at my laboratory in the theatre of St. Thomas's Hospital, which is a large place in the centre, or else in my own private room, which I had the means of darkening; and I can only say, that I am very much surprised to hear that so great a difference has been made elsewhere, as in none of our experiments did anything like that amount occur.

By Mr. LLOYD: We could not make more than a quarter of a candle in varying the distance. When we came within five feet of the wall, then the effect began to be perceptible; but as we kept beyond that distance it was not perceptible.

Mr. MAY (to Mr. Warington): In making astronomical observations, there is found to be what are called "personal equations"—*i. e.*, if three individuals observe the same phenomenon at the same instant, there will be a shade of variation in the result, which variation is almost consistent; so that, in conducting such observations at Greenwich Observatory, there is the personal equation to add or deduct in each case. Is there not something very similar to that in making photometrical observations? Is not the power of balancing two shadows by the eyes different in different persons? And may not the shadows from the wall, resulting from "personal equation," make all the difference we have been talking about lately? Has the question ever been started in photometry?

Mr. *Warington:* I think not. I have the reflectors of the photometer disc so arranged as to shift from one side of the photometer to the other, so as to be able to make the observations on both sides of the bar, in order to allow for any errors between the eyes, which are sometimes very great; because, in looking at the photometer, you get the reflected image in two small angles, and you get the two surfaces where they are perfectly equal. Then the right-hand side of the disc is looked at with the left eye, and the left-hand side with the right eye, and I have these shifted to go to the other side of the bar, so as to correct the observation.

By Mr. BARLOW: The object is accomplished by allowing for the errors of observation.

Dr. *Leeson* re-examined: From repeated trials, at which I think Mr. Croll was present, it was found that the difference between two observers scarcely ever exceeds a quarter of a candle; and with regard to the difference of rays, the same thing occurred to us as to Mr. Warington. We have an arrangement by which we can burn the gas at either end, so as to accomplish the same purpose. These observations of the illuminating power of the gas were taken for a considerable period by three independent observers. There was, first of all, Mr. Lewis Thompson, who experimented very much on the subject at the time; then there was Dr. Letheby; and, lastly, myself. My own observations were taken more frequently than the others; and you, having these results, can see at once the accordance or discordance.

Mr. BARLOW: The discordance is two, and sometimes three candles.

By Mr. ARCHIBALD: If we had been told that the standard candle adopted by us in our report of 1849 was to be increased to 140 grains, and that we were then to define the conditions of taking the observations, I think we should have adhered to that standard as closely as possible. We should have thought it right to make the experiments in sufficiently large rooms, to keep away from the influences of the wall, and then the result would have been as I have described it.

By Mr. BARLOW: The length of my photometer-bar is 60 inches.

By the UMPIRE: I confess I am sceptical about there being a difference of 25 per cent. The result would have been the same as now if the observations had been taken as they were in 1849. I should have looked upon any difference as an error of calculation. Then we had four different rooms, and we took the average of them.

By Mr. ARCHIBALD: If you take the relative angle at which the rays of the gas impinge upon the screen, you will find that it is much more obtuse than that from the rays of the candle. It would be more acute if you choose to take the inner angle, and, being more in the horizontal direction, the rays of the gas would not be reflected on the screen at all; and if the screen itself were sufficiently high, it would not affect it at the time.

The UMPIRE said Mr. Archibald would have to contend that the reports were, in point of fact, not made by the agent nor by the means agreed upon, and consequently, in point of law, were no reports.

Mr. ARCHIBALD: I say he is not the agent for this purpose.

The UMPIRE said the arbitrators would soon settle the question of agency if applied to to do so, but then Mr. Archibald would have to make out that this was no report at all.

Mr. ARCHIBALD contended that there was no right to alter the instrument. The contract was to raise the standard of illuminating power, but that standard never was defined and settled to Mr. Croll's satisfaction. He dissented because he said they had altered the instrument.

Mr. BARLOW: Mr. Archibald says you have made a yard into 40 inches, or something to that effect.

Mr. MAY (to Mr. Warington): Supposing this photometer-screen to be 3 inches in actual dimension (I understand you worked with a 7-inch chimney, and your flame was probably 5 inches), it is quite clear that only 3 inches of the height of that flame can be reflected upon it; and the same holds good as to the smaller amount of the flame of a candle.

Mr. *Warington:* The flame of a candle will not be 2 inches.

Mr. MAY: Then it is quite clear that the whole of the reflection of its flame will be transferred on to that screen, while only three-fifths of that from the gas will be transferred on the other side.

Mr. ARCHIBALD: The rays may reach the screen by subsequent reflection.

Mr. *Warington:* You will have a number of interferences. You lose sight of the immense interference of these rays by side reflections.

Mr. MAY: The problem I put to you is exclusive of all interference. I only want to get your assent to it.

Mr. *Warington:* It is one reason why we rejected Dr. Letheby's screen. We found, if we used screens at all, we must take into consideration the relative size of the gas flame. The rays of a gaslight which pass above, and below, and around the circular screen interfere materially with the direct rays coming from the candle—not reflected, but the parts that do not impinge.

Mr. MAY: If that screen were simply a screen of paper, that would be true; but I imagine you put that screen of paper in the centre of some other.

Mr. *Warington:* No, it is simply a circular disc in a circular frame.

Mr. WRIGHT: A quarter of an inch wide.

Mr. MAY: If it is half an inch wide, there is no longer any interference.

Mr. *Warington:* That does not make the disc of paper any larger in size. The paper comes up to the margin; it is 3 inches less than a quarter of an inch margin on each side.

Dr. *Leeson*, cross-examined by Mr. ARCHIBALD.

The communications in reference to my appointment to take the illuminating power were made to me directly through the secretary of the company, and also from time to time through the chairman. They always informed me, or gave me to understand, that I was acting both for them and Mr. Croll, but of their arrangements with Mr. Croll I knew nothing. I was paid by the company.

By the UMPIRE: I had various communications from time to time with Mr. Croll about the illuminating power of the gas. Mr. Croll has remarked to me that the returns which I made to the company differed from the observations of the illuminating power as taken by himself at the works. He

made a complaint about the darkened chamber. I had a discussion with him on several occasions. I saw him at the office, and I had him up in the room where the testing went on. I am not aware that he made that observation after some complaint about the illuminating power. I cannot remember sufficiently what led to it; I merely mean to say that in the general course of communication with Mr. Croll I always understood that I was employed conjointly for him and the company, and I am quite surprised to hear now that the question is raised. At the same time perhaps, if I had acted in a strictly technical way, I should have required from Mr. Croll, as well as from the company, some written communication appointing me. Mr. Croll originally introduced me to the company, and from that time until this question arose he always communicated with me, and led me to suppose that I was acting for both. I remember on one occasion when the darkened chamber was spoken of, assuring Mr. Croll that I was impartial in the way that I took the experiments, and that I considered myself bound to take them fairly, for as well as against him. I never made any claim on Mr. Croll for my services, nor received anything from him. The amount paid me was by cheque upon the company. We did have some communication about payment, because Mr. Croll gave me to understand at one time that he was to pay Mr. Graham, who was to be considered as his referee, and I the company's. I should have thought there was no use whatever in my taking the observations unless they were for the purpose of settling any questions between them. On one occasion there was some claim in dispute about retorts, and I was considered a sort of arbitrator between them, and asked to report which was right.

Mr. CROLL: That is long ago.

Witness: Yes; still I always thought that I was continuously so acting. I could not put my finger on any moment and say, I am now only to act for the company. As regards payments, I supposed all the arrangements were settled between them and Mr. Croll. Mr. Cooper gave me thoroughly to understand that he and Mr. Brande were called in at Mr. Croll's request, and I met them accordingly. That was in July, 1852; and they recommended verbally that I should be the person to go on between the two, and make the reports.

Mr. LLOYD: If you have any doubt about this point, Mr. Dakin will tell you they did recommend it.

Mr. DAKIN: In my evidence I stated that it was my impression Dr. Leeson was appointed by the other three gentlemen, and consequently by the company.

Witness: Perhaps I may be allowed to state that, so far, my impression is contrary to Mr. Dakin's. So far as Mr. Brande and Mr. Cooper are concerned, I can corroborate his opinion by what they said to me; but Mr. Graham certainly supposed after that time that he continued to act for Mr. Croll, and if any question arose requiring his interference that he would be called in.

By the UMPIRE: No question did afterwards arise requiring his interposition, nor did he ever make any observations to me except with regard to the payment of the £50.

Mr. DAKIN: There is a minute regarding the appointment of Dr. Leeson, July 30, 1855:—

At a board-meeting held this day, Mr. Croll reported that he had agreed and taken rooms for the purpose of testing the gas, &c.

Mr. CROLL: It was a question about the quality of the gas of the three companies—the City, the Chartered, and the Central.

Mr. BARLOW: That has reference to the minute of July 10.

Mr. DAKIN: It was recommended that a room apart from our own office should be taken for testing the gas, and it was arranged that the room should be taken at Charlotte's Coffee-house for the purpose of carrying that out; and then it was considered convenient that they should test the gas of the other companies supplying gas in the City—having regard to our own gas—and at the same time to test what the quality of our gas was.

Mr. LLOYD: It cannot be as Mr. Croll has stated. The minute goes on:—

Dr. Leeson stated that he was willing to undertake the superintendence of testing the gases at a cost not exceeding £50 per annum.

Mr. BARLOW: The minute of July 15 says:—

That Mr. Croll and the secretary be requested to hire the room at Charlotte's Coffee-house, Bucklersbury, for the purpose of having the gases of the three companies tested.

Mr. CROLL: Allow me to state how that arose. At that time the other companies had increased the illuminating power of their gas, and I had increased it also for the purpose of obtaining consumers; and Mr. Dakin having failed to get the consent of the other companies to lower their illuminating power, a memorial was presented to the Commissioners of Sewers, and it resulted in the companies desiring to have a room to have the gases of the three companies placed in juxta-position, and the illuminating power taken, for the purpose of producing an effect on the commissioners. That was the object of taking the room; Mr. Dakin, I dare say, remembers it.

Mr. DAKIN: I remember no such thing as to our proposing to get the other companies to reduce the illuminating power.

Mr. CROLL: You forget a great many things; there are your letters.

Mr. DAKIN: If there is any letter between me and any member of the Chartered it will show it; but it is not as you state it. I would suggest that Dr. Leeson, who is here, could tell you what the room at Charlotte's Coffee-house was taken for, inasmuch as he was the party who made the experiments.

Witness: The return states the room is taken at Charlotte's Coffee-house, and in this return there is nothing about the Chartered or the City gas.

Mr. CROLL: There was a room at the office of the company formerly, and you remember perfectly well our being unsuccessful in obtaining the gas of the Chartered; you remember repeated times we went there for the purpose of comparing one gas with the other; I am speaking of a fact?

Witness: In reference to your visits to Charlotte's Coffee-house, in conjunction with me, my impression is, we thought it very desirable to have an opportunity of examining the other companies' gas; still the object of taking the room was the test, and the room at the office was objected to as not being the best place: I was turned out of my room.

Mr. CROLL: Do you not remember all the experiments made by you and your predecessor were made in the office when you were taking the illuminating power; was there any reason for going to Charlotte's Coffee-house?

Witness: Yes, a very strong reason; because Dr. Letheby insisted on having the room to himself, and would not let me go into it.

Mr. CROLL: Dr. Letheby had the same room as he had then. You made the experiments in the same room. There was no difficulty in dividing it off.

Witness: If you will allow me for a moment to explain. I tell you I was virtually turned out, in consequence of Dr. Letheby being appointed by the City, and there was a great difficulty in getting any other place. The room I wanted to have was the room adjoining the board-room. I was disappointed; I did not get it. Then it was thought and represented to me it would be better for many reasons to take the gas to some place in the midst of the consumers, and we were then transferred to Charlotte's Coffee-house, there being at that time no other room at the office where it could be taken, unless a room had been specially fitted up. After a time the company thought it was an unnecessary expense keeping on the room at Charlotte's Coffee-house; and then it was that it was transferred. But certainly, if I referred to one period more than another when I should infer, from all that passed between you and myself, that you considered me as acting for you, it was that very period.

By Mr. BARLOW: We could not get the gas of the three companies at Coleman Street office. That was one reason among others, but certainly not the only reason.

By the UMPIRE: For many months I continued by myself making reports. The date of the first is October, 1852, and I continued to do so down to 1856. I have seen very little of Mr. Croll during the last two years and a half, as I have been in the country.

By the UMPIRE: In 1852, 1853, and 1854 I was in the habit, when in London, of seeing Mr. Croll from time to time, and we have occasionally adverted to the subject of my making reports; and whenever I have adverted to the subject, I have always considered that Mr. Graham was associated with me, and I think I mentioned to Mr. Croll what the arrangement between him and the company was.

Mr. DAKIN (in answer to Mr. Lloyd) said that Mr. Croll was present at the meeting on July 22, when the minute just referred to was adopted.

Mr. CROLL: You will observe there that Dr. Leeson does not make any report till October, 1852. I was not aware of his taking the illuminating power till he commenced to make the reports; then I objected to it, and the answer Dr. Leeson made was, that an allowance was made for the difference between the mode in which it had been taken before and the mode that he then adopted, and that the one would be equal to the other. That quieted me, to a certain extent, although I believed to the contrary; and then, after Dr. Leeson made the report of October, 1852, for my own security, after having mentioned and objected to Dr. Leeson, I then obtained the report of Dr. Letheby, to show the difference between the one mode and the other. The date of that report was December, 1852.

Mr. DAKIN: Both Mr. Croll and Dr. Leeson were present on that occasion. I remember the time when this minute was made—

Dr. Leeson being present, the chairman stated to him the conversation which they had together respecting the room and the person employed in testing the three gases.

Mr. Croll was there at the time, and Dr. Leeson stated that he was willing to undertake the superintendence of testing the gases at a cost not exceeding £50 per annum. That refers to the company's gas.

Dr. *Leeson* re-examined: I never undertook to test the Chartered or the City Company's gas.

By Mr. BARLOW: Once or twice I have had sums from the company for extra work.

The UMPIRE: Mr. Dakin, did you ever after December, or at any time, hear from Mr. Croll of Dr. Letheby's having made a report that was inconsistent with these reports of Dr. Leeson?

Mr. DAKIN: I heard of that report from Mr. Croll—that he had such a report—but I never saw it in my life; I should have remembered that drawing upon it. I could not have seen that without remembering it. I remember Mr. Croll did tell me he had a report from Dr. Letheby, and I think at one time he did state that he thought the illuminating power was taken unfavourably for him; but he never made the slightest complaint as to the mode of taking it, having reference to the rights of the company and himself under the contract. It was a subject of complaint he used as a part of his general loss whenever he made a complaint in that sense. He was acquainted with the fact that Dr. Leeson was making these monthly reports from the year 1852 up to 1857.

Mr. CROLL: Dr. Leeson did not begin till October, 1852.

Mr. DAKIN: I am sorry to hear Mr. Croll repeat aloud to his counsel that I have had that report in my hand at the corner of Abchurch Lane.

Mr. CROLL: I swear positively you had it nine months ago.

Mr. DAKIN: That is about the time you mentioned it. Will you allow me to state, I perfectly recollect this meeting I had with Mr. Croll at the corner of Abchurch Lane; it was a long and stormy meeting we had at that time; and I remember a paper which he put into my hand, and I returned it to him; but it was another paper which he has spoken of my handing to Mr. Pearson, and not that paper.

Mr. CROLL: That was the report in reference to the illuminating power?

Mr. DAKIN: It was in reference to an increase of price. I believe I never saw that report till this time.

The UMPIRE: Mr. Croll, did you ever apply to the company, the secretary, or to the chairman or deputy-chairman, to say you were dissatisfied with these reports of Dr. Leeson?

Mr. CROLL: Decidedly; I applied immediately or shortly after Dr. Leeson commenced to make his reports; and, in consequence of that dissatisfaction, I asked Dr. Letheby to make a report, to show me the difference. This report was obtained for the express purpose of showing to the directors the different modes adopted now to what there were before, and I handed this report, not to the board, but to Mr. Dakin or to Mr. Gabriel; certainly to Mr. Dakin after the date of this report, December, 1852; and I suggested at one time that Dr. Letheby should make the experiments, and an allowance be made equal to the difference in the reports. I suggested that, and it was agreed to, as I understood; and then they made out a letter, and asked me to sign it, that I would take Dr. Letheby's reports irrespective altogether of the difference; and I refused to sign that letter unless the difference was allowed.

The UMPIRE: Did you make any application to them that instead of Dr. Leeson, with whose reports you were dissatisfied, they should employ Mr. Brande, or Mr. Cooper, or any other person?

Mr. CROLL: Not further than I have stated.

Dr. *Leeson:* It is a pity you had not told me of that report, and let me go into the experiments at the time. I had not heard of it until summoned here as a witness.

Mr. CROLL: The company chose to bring forward a memorial to the Commissioners of Sewers that states the difference between Dr. Letheby's and Dr. Leeson's method of testing. They said it made a difference close to the difference I claimed in that respect, and I was satisfied.

Mr. LLOYD: You stated the contract with you was for manufacturing gas, to be measured by the scale laid down by a person competent to make it.

Mr. CROLL: You will observe, in answer to that, that the memorial was presented before Dr. Leeson began to make his reports; and, as I stated to you before, I was not aware of the effect that that report would have on my interests.

The remainder of this sitting was occupied with the consideration of a claim for consequential damage, which was afterwards abandoned.

(*To be continued.*)

Miscellaneous News.

LUTON LOCAL BOARD OF HEALTH AND THE GAS COMPANY.

At the first Weekly Meeting of the Board held in the present month the chairman read a report from Mr. Hedley, gas engineer of Banbury, who had been appointed by the board to test the gas supplied to the town, for the purpose of ascertaining whether it was of the proper illuminating power, &c. The following is a copy of Mr. Hedley's report:—

To the Luton Local Board of Health.

Gentlemen,—In compliance with your request, I visited Luton for the purpose of inspecting the public lights, and also to test the gas as supplied to the town, and I now beg to report the result of the same.

On Monday evening, the 25th inst., I examined a portion of the town, and saw some very fair 4-feet flames, but the majority of the lights were small.

On Tuesday, the 26th, I tested the gas by means of a photometer, first at Mr. Tansley's, and afterwards at the offices of the local board, and arrived at the same result from each experiment, viz., that when 5 cubic feet of gas was consumed in the manner specified in the "Luton Gas Act," it gave a light equal in intensity to that of eight sperm candles. To give a light equal to the standard mentioned in the Act, viz., twelve candles, required 6½ cubic feet of gas.

In the evening of Tuesday I inspected the whole of the district, and found occasionally a burner giving a flame equal to 4 feet of gas, but the very large portion of them were not doing so, the light not being equal to 3 feet of 12-candle gas.

On Wednesday morning I attended at the gas-works, having given the necessary three hours' notice to the manager of my intention to do so. I was most courteously received by Mr. Phillips, and found everything prepared for my reception. The gas then being used I found to be equal to full 14 sperm candles.

Immediately upon leaving the gas-works, I returned to the office of the local board and re-tested the gas, *and again found that the gas being supplied to the town was only equal to* 8 *sperm candles.*

On my return to Banbury, I had my apparatus fixed at my offices in the town, and with the same burner and candles, and everything being precisely the same as in use at Luton, I found that the gas being supplied by the Banbury Gas Company was equal in illuminating power to 14 candles. I should say that my experiments were carried on for several hours. I am, Gentlemen, yours very obediently,

Banbury, Oct. 29, 1858. T. A. Hedley, Consulting Engineer.

The Chairman: With respect to the report of Mr. Hedley, I think it should not pass without an expression of our opinion, or without some steps being taken in respect to it.

Mr. Tansley: I propose that a person be appointed as an inspector of meters under the Gas Company's Act, who shall also be required to superintend the testing apparatus of the board.

Mr. Willis seconded this proposition, which was carried unanimously.

The local papers have since contained the following curious correspondence on this subject:—

To the Editor of the Luton Times.

Sir,—In the report which Mr. Hedley has furnished to the Board of Health of his examination of the Luton Company's gas, and which will doubtless appear in the papers of to-morrow, it is stated that Mr. Hedley found the quality of the gas on the 26th to be 8 candles, while on the works the following morning he found it to be 14 candles; and again, after leaving the works, he found it later in the same day, 8 candles. The intention of this is to leave those not versed in these matters to infer that the gas examined on the works was not the same article as that distributed to the town—THIS I TOTALLY DENY, and am willing to make oath in any court, or before any competent authority, that the gas tested by Mr. Hedley was the gas passing through the pipes into the town for general consumption; and further, that it was again tested in the same way five hours later (still passing into the town), when the quality was 15 candles, same as in the former trial. How it could possibly leave the 15 candles and become 8, some 400 or 500 yards away, I must leave those who read this to form their own opinion of—my experience does not teach me. The gas distributed to the town had been tested four times during the preceding seven days, and was not in any case so low as 12 candles.

With regard to that part of the report which relates to the size of street lights. The Board of Health agree for No. 4 burners calculated to consume 4 feet per hour, and they have a clause in their contract that any burner which is thought to be less than this, shall be taken down and tested, and, if found not large enough, shall be exchanged according to their direction.

I am sorry to trouble you, sir, at so great length (or indeed at any even the smallest space), but I am anxious the public should be able to form a cool and unbiassed opinion on a subject which seems to have some Phœnix-like properties.

I am respectfully yours, &c.,

Gas Company's Office, Luton, Nov. 5, 1858. W. Phillips.

To the Editor of the Luton Times.

Sir,—My attention has been drawn to a letter in your paper of the 6th of November, which, after stating the result of my testing the illuminating power of the gas, goes on to say, "The intention of this is to leave those not versed in these matters to infer that the gas examined on the works was not the same article as that distributed to the town."

You will oblige by allowing me to say, that my intention was only to convey to the local board a plain statement of facts, and which I am prepared to verify if necessary.

The apparatus with which I tested the gas at Luton has been in daily operation at my offices here, and with results varying from twelve to fifteen candles, and would have shown the same result had the gas experimented upon at Luton, on the 25th and 26th of October last, been sufficient illuminating power.

I am, Sir, yours truly, T. A. Hedley,

Banbury, Nov. 11, 1858. Associate Institution of Civil Engineers.

WATER SUPPLY TO GREAT TOWNS:

ITS EXTENT, COST, USES, AND ABUSES.

By J. Strang, Esq., LL.D.

[Read at the British Association for the Advancement of Science, Leeds.]

From the peculiar constitution of man, it need scarcely be stated that water has necessarily been to him an object of primary importance. From the earliest records and monuments we find, wherever human beings happened to be congregated, that this primary element of their existence became an object of chief attention, and that it was only where this great desideratum was abundant that masses of mankind were found to exist. It followed, therefore, that wherever cities were not established on the banks of pellucid streams, but on the sides of rivers the purity of which had become inappropriate for domestic uses, that artificial means were adopted to furnish what was requisite for the use and comfort of the inhabitants. Amid the ruins of Eastern grandeur, and the still remaining aqueducts of Rome and other cities of the West, abundant evidences still exist of the anxiety manifested for supplying water for their inmates, and for the embellishment, through monumental fountains, of the cities themselves. In modern times an abundant and pure supply of water for the great and growing cities of the world has been a peculiar characteristic of legislation and enterprise; and in our own days water-works upon the most gigantic scale have been completed, are in progress, or are projected, to minister to all the exigencies which advanced civilization, modern comfort, and increasing luxury may require. Let us endeavour to show, by a few statistical facts, derived from the best and most authentic sources, the present and projected water supply of a few of the leading capitals of the Western world, with the extent and cost of such supply, and with some of the social advantages, and even evils, which have arisen, or may still further arise, from rendering water the too easy agent for the removal of impurities which should be transported otherwise, and thus converting many once pellucid streams, upon which so many cities are founded, into deleterious and noxious common sewers, detrimental to comfort and hostile to health.

We shall begin with

London,

which is at present supplied with water by ten independent companies. The chief sources of supply are from the river Thames and the river Lea—five of the companies, with a daily supply of 35,372,782 gallons, being furnished by the former, while two companies, with a daily supply of 41,000,000 gallons, are furnished by the latter. The remaining three companies, with a supply of 4,653,000 gallons, are taken from the river Ravensbourne and the ponds and chalk wells of Hampstead, Plumstead, and Woolwich. The great power employed for its distribution is steam applied to pumping, amounting to a nominal power of 7254 horses. The length of the mains and branches extend to 2086 miles. The area of subsiding reservoirs extend to 141 acres, and of filter-beds to 40 acres. The number of houses supplied amount to 328,561, and the gross quantity supplied per day reaches 81,025,842 gallons. The entire cost of the several works in the year 1856 was £7,102,823, which shows that for every pound expended there is a daily supply of 11·4 gallons.

Few cities have improved their water supply in the course of a few years more than London, both in quantity and quality. In 1850 the whole number of houses supplied were only 270,581, whereas in 1856 water was furnished to 328,561 of the 340,000 houses which now form the aggregate within the Registrar-General's district; while the daily supply of water for all purposes, which in 1850 was 160 gallons per house, was in 1856 no less than 246 gallons. In 1857 the whole population within the bounds of supply amounted to 2,667,917, which leaves, after deducting one-sixth for trade purposes, 26 gallons for every individual. or, without deduction, 30·4 gallons. Previous to the passing of the Metropolis Water Act of 1852, considerably more than half of the supply was not filtered, the impurities in suspension being alone cleared by subsiding reservoirs. Now, however, no less than an area of 40 acres of filters have been added to these subsiding reservoirs. According to the chemical report of Messrs. Hoffmann and Blyth, the waters now supplied to the whole metropolis contained not more than one-half of the organic matter which was present in these during the year 1851—a diminution of organic matter which, it appears, is neither due to the influence of the season nor to any difference in the mode of determining its quality in 1851 and 1856, but solely to the alteration of the localities from which many of the companies derive their present supply, and to the manifest improvement which has taken place in the collection, filtration, and general management of the supply of the metropolis. It has been stated by the Board of Health inspectors that the various companies have more than complied with the obligations placed upon them by the last parliamentary Act, and have evinced a most anxious desire to discharge the duties imposed upon them for the public good. The only difficulty experienced in drawing supplies from such rivers as the Thames and Lea arises from the increased and increasing drainage operations pursued by the towns and villages situated on their banks, which, by discharging therein their polluted sewerage even above the improved sources of supply, threaten ere long to contaminate or destroy such an enormous supply of what is yet pure and sanitary, if measures be not immediately adopted, indeed, for the prevention of this growing evil—an evil which, by poisoning all large streams, cannot be remedied without a total abandonment of the whole present system of town drainage, and of turning the sewerage to some useful instead of deleterious purpose. This, indeed, is the great problem of the day; for while London at this moment can boast of a water supply fully commensurate with the just demands of its mighty population, it is at the same time threatened from the drainage which its abundant supply of water so greatly facilitates with a pestilential evil, against which it is the imperative duty of every well-wisher for the comfort and health of the greatest metropolis in the world strenuously to combat.

Let us now turn to the water supply, present and prospective, of the French capital, which, among its other late magnificent embellishments, has not been inattentive to the advantages of an improved supply of water.

Paris

is at present supplied with water from various sources. The maintenance of the water-works and the expense of distributing the water are paid by the municipality. The sources whence the supply are brought are—firstly, from the Canal d'Ourcque, by gravitation, which is 52 mètres above the level of the sea, and about 20 mètres above the lowest point of Paris; secondly, from the river Seine, whence it is pumped by steam-engines, and raised to the varied height of 75·30, 72, and 66·24 mètres above the level of the sea, and to 43·30, 40, and 34·24 mètres above the lowest levels of Paris; thirdly, from the artesian well of Grenelle, the basin of which is 90 mètres above the level of the sea; fourthly, from the aqueduct of Arcueil, the reservoir of which is 57·39 mètres above the level of the sea; and, fifthly, from sources to the north, which are at much greater elevation, but which, in respect of quantity, furnish but little water. The water d'Ourcque is distributed to all the low or less elevated quarters of the city, or to about two-thirds of the entire surface of the town; the others supply the higher districts. The total length of the principal conduits is 218,213 mètres; the length of the smaller pipeage extends to 190,048, or to a total of 408,254 lineal mètres, or about 253·6 English miles. The length of the conduits of the water d'Ourcque extends to 281,525 mètres, while all the others are only 126,729 mètres. The whole length of the streets of Paris is about 400,000 mètres, which is less than the extent of the pipeage; but there are many streets without water, while there are several with a double pipeage. It would require about 30,000 mètres of small pipeage to give water to all the streets of the capital. The daily quantity that can be at present sent into Paris is as follows:—

Water d'Ourcque	102,000	mètres cube.
„ from Seine	30,000	„
„ from Grenelle	950	„
„ from Arcueil	700	„
„ from northern sources . . .	200	„
	133,850	„

or about 29,417,000 gallons.

The total quantity distributed varies considerably. During the hot weather of last year the consumpt rose to about 120,000 mètres cube—viz., from l'Ourcque about 100,000 mètres cube, and from other sources 20,000 mètres cube. In winter the consumpt diminished much, but never below 70,000 mètres cube. The number of houses within the boundaries of the water supply of Paris amount to upwards of 30,000, of which only 9936 were, in December, 1857, supplied with pipes, showing that scarcely a third of these receive water directly. The population amounts to 1,093,262, and the number of the houses directly supplied with water being only a third of the whole, it follows that not more than 351,081 persons are enjoying the advantages of water within their houses. Assuming that 120,000 mètres cube, or

26,350,000 gallons, are sent daily into Paris, and that the population amounts to about 1,100,000, it shows that there is a daily supply afforded of about 24 gallons to each individual inhabitant. The quantity, however, actually used for domestic purposes is, comparatively speaking, small. It has been calculated that the average daily quantity furnished to each house into which pipes are introduced into the court is about 1444 litres, or very nearly 10 gallons for each inhabitant in such houses. But the average quantity of water furnished to the whole city (one-fifth of the surface of which is above the level of the distributing reservoirs of the several sources) amounts only to 750 litres per day to each house, or to 5½ gallons per individual. It appears, in fact, that, between the *fontaines monumentales* and the purposes of trade and police, about three-fourths of the volume of water is consumed, and that little more than one-fourth is used for domestic purposes. It may be here remarked that the inhabitants of the French capital have not yet made use of water as an agent for carrying off the impurities of their houses into the sewers which debouch in the river, and consequently the Seine has not yet become, like the Thames, a great *cloaca maxima*, but is still pure—an ornament, and not a nuisance to the city. The peculiar character of the present sewerage of Paris is, that nothing but the rain and waste-water of fountains, or other uncontaminated water, go directly to the Seine, the soil, &c., of houses being run into tanks attached to each building, which are cleaned out at certain times, and carried away to La Valette, beyond the bounds of the city.

It may be supposed strange that in such a city as Paris, where there is water in almost every leading street, and where it is given at a very low price to all who wish it, there should be so few proprietors who take it in. The explanation, however, is very simple, and arises from the two following causes:—First, the rich population continue, as formerly, to take the water for domestic purposes from the carriers of water, drawn from fountains, in which the water of the Seine is carefully filtered, and absolutely refuse to drink the water of the Ourcque Canal; while, secondly, the poor population avails itself of the 2000 *bornes fontaines*, or pipes opening in the streets close to the kerb-stone, and of the 69 public fountains scattered throughout the city, whence any quantity of water required may be drawn, free of any cost. It appears that the market fountains, the State and the municipal establishments, consume about 13,000 mètres cube; the remainder, or 77,000 mètres cube, is expended on the streets and roads, through the *bornes fontaines* and the 69 drawing and 33 monumental fountains, and, in fine, on the Bois de Boulogne, where there is alone not less than 16,000 mètres cube expended. In throwing so large a volume of water along the public thoroughfares, and in permitting the drawing of supplies from so many openings, the municipality has not succeeded in the end which they proposed to attain. If these public openings were suppressed, the proprietors of houses would each and all be forced to become recipients of water from the city, enabling their tenants thereby to draw water in the courts instead of seeking it in the street, while the street would be freed from two running gutters which line each of the foot pavements. Up to this moment all the water introduced into houses is drawn from stop-cocks placed in the courts, the proprietors having obstinately refused to distribute it throughout the interior of their property, fearing, as they say, the accidents which might arise from the negligence of their tenants. What the present cost of the water supply of Paris has been it is difficult to say. Certain of the works have existed for 250 years, while the Canal d'Ourcque, which affords the greatest supply, was formed for navigation purposes, for which it is still chiefly used. According to the valuation of M. Belgrand, the chief engineer of the present and projected works, we may assume the cost of the existing works at about 20,000,000 francs, or £809,000 sterling; and, taking the daily quantity of water that is sent into Paris to be 26,350,000 gallons, it follows that for every £1 expended there is provided a daily supply of about 33 gallons. To meet the interest of this cost and annual expenditure there is no special tax or forced rate, proprietors being free to take or not, as they please, the water of the city; but those who take it into their houses pay a very small annual charge. The gross receipts from water paid annually to the municipality in 1857 was only 1,276,550 francs, while there was received from the fountains where the filtered water of the Seine is sold 390,499 francs, or a total of 1,666,950 francs, or £66,680 sterling.

Such is the present state of the water supply of Paris; but it is now resolved to alter the whole system, and to bring in a purer and greater supply from the sources of the *Somme-Soude* by gravitation. Considering that the water is to be brought by aqueducts and conduits from a point between Epernay and Châlons-sur-Marne, in Champagne, a distance of nearly 124 miles, it will not be denied that the project is a bold one, and can only be attained at a vast cost; but under the present energetic Government nothing seems too mighty to be accomplished. The point of departure at the source is 104 metres above the level of the sea, the point of arrival at Paris being 83·50 mètres. The size of the circular conduit will be 2 mètres in diameter, the length 200 kilomètres, and the fall 0·10 mètres per kilomètre. The water, to the extent of about 20,000,000 of gallons per day, on approaching the capital, will flow into the reservoir of Belleville, situated about 200 mètres beyond the barrior of Panton. This reservoir will fill two others, that of Montrouge, situated on the south side of the city, at 80 mètres above the level of the sea, and also beyond the barrier, and that of Passy, which is situated on the north-west of the city, at 75 mètres above the level of the sea. These three reservoirs will contain together 240,000 cubic mètres of water (about 53,000,000 gallons), or about 2½ days' supply. The cost of each reservoir will average 1,600,000 francs. The main and small pipeage will be placed in open tunnels for sewerage, where these exist, and where they do not, they will be laid in the ground. The most elevated portions of Paris, but which occupy a small extent of the city, are 60 to 64 mètres above the level of the sea; the height, however, of the chief portion does not exceed 40 mètres, while the greatest height of the houses is 17·50 mètres. The water will consequently easily reach the higher flats of the greater part of Paris, and the lower flat of every house even in its most elevated parts. The contemplated cost of the undertaking, including the expense of the aqueduct, collecting the water, the indemnity to landowners, and works, is estimated by the engineer at 26,000,000 francs; but the grand council of roads and bridges have put down the expense at 30,000,000, to which the expense of distributing reservoirs and mains, amounting to 17,000,000, must be added, making the whole contemplated cost 47,000,000 francs, or £1,880,000 sterling. It is proposed that the present pipeage, which is in a very perfect state, should be made use of, and that the water from the Canal d'Ourcque should be reserved for public purposes, but not distributed in greater quantities than at present. It is also proposed that, in order to make use of the 100,000 mètres cube easily obtained from this source, additional sewers should be constructed throughout Paris, the half of the streets being only at present furnished with these, which will create an additional expense of 43,000,000 francs, or a total cost of 90,000,000 francs—or £3,600,000 sterling—for the complete sanitary improvement of Paris. The question necessarily arises, how the interest of this large outlay is to be met, and the answer is, by a rate from those taking the water. This, it is apparent, will be considerable, for if we add to the 9936 proprietors who already pay the rates paid by public establishments, it will be found that the total number of those taking water from the city is 10,115, which produces, as already stated, 1,276,550 francs; and if these receipts be added to the tariff of the water of the Seine, which is very moderate, they will produce at least 2,300,000 francs, which shows the average sum from each ratepayer to be 227 francs, or say 230 francs; and if the 30,000 houses of Paris take the water at this price, the total gross receipts will be 6,900,000 francs, and, deducting therefrom the present receipt of 1,700,000 francs, shows a receipt for the new supply of 5,200,000 francs, which represents about 11 per cent. on the capital (47,000,000) employed. It is very probable that every house in Paris will take the new water at a price even higher than that of the filtered water of the Seine. Indeed, the rich population will no longer have any objection to urge against the new supply, which will be distributed fresh and clear, and which will be even more agreeable to drink than the filtered water of the Seine. The proprietors also of workmen's houses will be induced to take the water in consequence of—first, the proposed gradual suppression of all the public fountains, which form a real obstacle to the circulation of the city; secondly, by removing the side-cocks on the streets and placing them under the pavements, where the drawing of water would be impracticable for domestic purposes, and which would be likewise more convenient for pedestrians; and, thirdly, by permitting all the ratepayers the liberty of running their soiled water into the public sewers, which is now collected in tanks attached to each house, and which are emptied at a cost of 8 francs per cube mètre. The liberty of doing so should, however, only be granted when the proposed great lineal sewers on each side of the Seine are formed to carry off the sewerage of the capital to the country, and which will maintain, as heretofore, the purity and the salubrity of the Seine.

As yet Paris, as we have seen, has not been permitted to make use of the easy agency of water to carry off its impurities into an adjacent river, and which has proved such a nuisance and growing difficulty to other large towns; and it is to be hoped, for the best interests of that beautiful capital, that every precaution may be taken, when a more abundant supply tends to induce such a use, to prevent an evil similar to that now experienced in many of our British cities.

Turning from the capitals of England and France to the commercial capital of Germany, we find that

HAMBURG

is supplied with water by pumping, and has an average daily supply of 5,000,000 gallons. The population within the bounds of supply is 160,000, which shows a daily supply of 31¼ gallons for each inhabitant. The works and distribution are under the charge of the municipality, and the gross cost of them was £170,000, which gives about 29½ gallons daily for every pound expended. The number of baths and water-closets supplied with water amounts to about 6000. The annual expenditure is paid by the following rates:—First, for domestic purposes, 2s. 6d. for every habitable room, kitchen, water-closet, or bath, within the premises; secondly, for every 1000 gallons used for trading or manufacturing purposes, 6d. The soil of the city is collected by a system of sewers, which are discharged considerably below the city, and at ebb-tide.

Leaving Europe, let us next look to the commercial capital of America,

NEW YORK,

which is supplied with water from the Croton river, about forty miles distant, and is brought to the city by aqueducts, upon the principle of gravitation. At the farther point a reservoir has been constructed, the area of which is at least 400 acres, and is capable of containing 500,000,000 gallons. From this there is an aqueduct, built of stone and brick, 8 feet 5 inches high, and at the bottom 6 feet 7 inches wide, which conveys the water till it reaches the Haarlem river, which is crossed by a stone bridge 1450 feet long and 114 feet above the tidal flow. From this it is conveyed to a receiving reservoir, capable of containing 15,000,000 gallons, and then to a distributing reservoir, which supplies the city. This undertaking was begun in 1835 by the municipality of New York, and finished at a cost, for the aqueduct alone, and exclusive of the pipe distribution through the town, of about 9,000,000 dollars, or £1,800,000 sterling. The pipeage for the supply and distribution of the Croton water from its introduction till the close of 1856 extended to 254 miles 4490 feet. In 1849 it only extended to 193 miles, showing an increase in seven years of 61 miles. The pipes employed are from 4 to 48 inches in diameter, viz.:—

48	inches	4,087 feet.
36	„	60,878 „
30	„	44,862 „
24	„	5,400 „
20	„	34,865 „
16	„	14,083 „
12	„	275,645 „
10	„	5,875 „
6	„	899,449 „
4	„	9,472 „
	In all	1,354,616 „

The number of separate dwellings supplied during the year 1857 amounted to 57,458, and the gross quantity supplied per day was 28,000,000 gallons. The whole population furnished with water within the boundaries of supply was, last year, 713,000, which shows nearly 40 gallons per day for each inhabitant; but, deducting a sixth for manufactories, leaves for domestic and public purposes and waste 32½ gallons for each individual. The number of private shower and plunge-baths in New York in 1857 was about 18,813; and the number of water-closets, public and private, amounted to 40,209—showing that there existed a bath for every 38 persons, and a water-closet for every 17 persons, within the range of supply. Taking the gross cost of the aqueduct works, which amounted to £1,800,000, and the daily supply at 28,000,000 gallons, it follows that for every pound sterling expended there is a daily supply of 15·5 gallons. To meet the interest of the original cost and the annual expense of these water-works, a compulsory rate, amounting to about 5 per cent., is raised from every building standing upon a street in which a pipe is laid, whether the water be introduced into the house or not; but this rate, from the great fall in fire insurance which has followed the introduction of the Croton water, is little felt, or at least not complained of. The yearly revenue derived from the Croton water during the year of its first introduction was only 84,444 dollars, whereas in 1856 it amounted to 662,949 dollars. The regular rate is from 4 to 100 dollars for each dwelling, but extra charge is made on houses having more than fifteen persons residing therein. From this source about two-thirds of the revenue is derived; the other third is raised from manufactories, horses, hotels, refectories, saloons, slaughter-houses, steam-engines, steam-boats, shipping, water-closets, &c.

Perhaps there is no city in the world where in so short a period such an increased consumpt of water has been experienced as in New York. At the first introduction of the Croton stream, it was thought that from this source there would always have been got a sufficient supply to meet every future demand, arising either from an increase of population or of use. But already it appears there is little water to spare, and complaints are also making that the water does not rise in different localities sufficiently high to supply customers who have paid for its use. The cause of this unexpected position of matters arises, not from a want of water to meet all the domestic and other legitimate demands of the inhabitants—for out of the 28,000,000 gallons furnished, only 7,500,000 are used in dwelling-houses, and 4,500,000 in manufactories—but from the extraordinary waste which has resulted from the first over-abundant supply—a waste which, here as in other cities similarly situated, has begun to be seriously felt, but which it is difficult to control. The truth is, that water has become the easy agent for the removal of much that formerly, and should still be carried away by other means. In consequence of this great waste, it has been already gravely proposed by the Croton Board not to supply elevated buildings and upper storeys of houses with water, believing that here lie the chief sources of excessive consumption and enormous waste, and that the unnecessary consumption in families, hotels, and boarding-houses would not be one-tenth of that which is now committed in those buildings, if the policy had been settled at the commencement of the system, that service-pipes should not be allowed in such premises above the first storey. It is also stated that the New City Reservoir, about to be commenced, would not have been considered necessary, at so early a period in the history of the water-works, for the protection of human life and the support of all the great interests of the city, had care been at first taken to prevent this abuse. The only other remedy suggested to diminish this wasteful consumption is the water-meter, and already several of the larger establishments are furnished with these measurers, and the system it is thought may be in time extended to dwelling-houses. In short, with all the supposed endless supply of the Croton Water-Works, the Aqueduct Board, in a late reply to a demand made upon them by the Street Commissioners for the free use of the Croton water, for the purpose of thoroughly cleansing the gutters every night, peremptorily refuses to accede to it, on the ground that sewers are not intended for carrying off the surface filth or deposit, while the expense to the public for thus carrying off what should be carted away, would be twenty times as costly as the mere throwing of it into carts from the pavement; and secondly, and chiefly, as they state in their last report, "that already the energies of this department are taxed to the utmost to keep up a sufficient head in the reservoir to preserve the city from fire and to answer the legitimate demands of the inhabitants. It is indisputable that we have not a gallon of water for any other purpose than the present to spare!"

If London, Paris, Hamburg, and New York have not been inattentive to obtain a plentiful supply of pure water, it may also be stated that a number of the larger provincial cities and towns of England and Scotland have wisely followed their example. The great water-works of Manchester, Liverpool, Birmingham, Leeds, Carlisle, &c., fully attest what has been done in the southern portion of the island, while the works of Edinburgh, Aberdeen, Greenock, Paisley, Dundee, and the gigantic undertaking now fast progressing at Glasgow, testify to what has been, and is still doing in the north. With respect to the important English provincial undertakings just mentioned, we shall only allude shortly to those of Manchester, Liverpool, and Leeds. Until very lately

MANCHESTER

may be said to have been ill supplied with the first element of life. The water-works, however, designed and executed by Mr. J. F. Bateman, which are now nearly completed, have placed that city in the best possible condition. The water, which is soft and pure, is drawn from a considerable distance, and is brought to the city by gravitation. The management of the works and the distribution of the water are in the hands of the City Corporation. The total daily supply for all purposes is at present about 11,000,000 gallons, and the population within the bounds of supply being a little over 500,000, shows about 22 gallons a day for each inhabitant. The separate dwellings, which are nearly all supplied, are about 100,000. The gross cost of the works is about £1,300,000, including the purchase of the old company; and when the works are fully completed, it is calculated that they will furnish a daily supply of 25,000,000 gallons, which shows that for every pound expended there will be a daily supply of nearly 20 gallons. The present supply shows only 8 5 gallons for each pound expended. From the as yet limited number of baths and water-closets, the consumpt of water for domestic purposes is comparatively small, while there is a proportionally larger quantity used for trade purposes than in other towns. The supply of water by the Manchester Corportion is of three kinds—first, that for domestic purposes within the city, for which a compulsory rate is levied; secondly, the supply to adjoining districts, in a manner similar to a private company, and for purposes of trade within the city; and, thirdly, the supply to other burghs, &c., such as Salford, where the distribution of water and the collection of the rates are in their own hands.

The supply of water for

LIVERPOOL

is brought from several sources, and is under the charge of the corporation. The average daily supply is 11,000,000 gallons, and the population within the bounds of supply, including sailors, being estimated at 500,000, shows 22 gallons for each inhabitant. Of the 11,000,000 gallons furnished, it is calculated that 65 per cent. is used for domestic purposes, 27 per cent. for trade, and 10 per cent. for public purposes. There are about 72,000 separate dwellings supplied. The number of baths and water-closets is not exactly known, but the estimate of these has been stated at 6000. The whole cost of the undertaking, including claims yet outstanding, amounts to £1,640,000, which shows that for every pound expended there is a daily supply of seven gallons. Like many other towns, the waste of water in Liverpool is considerable. One of the causes of the waste arises from the introduction of water-closets into cottages. It is not, however, a general practice to wash away ashes and filth of that character through the water-closets or drains, nor by the public sewers. In all cases where property is drained, a branch is carried to the ash-pit, and thus much that is in other towns, where an abundant supply of water prevails, carried into rivers, is carted away.

The chief water supply for the town of

LEEDS

is brought from Arthington, about ten miles distant, where it is pumped into a reservoir, from which it is distributed to the inhabitants. The works and distribution are under the management of the corporation. The average daily supply at present is about 1,850,000 gallons. The number of separate dwellings supplied in March last was 32,312, the population supplied being about 153,000, or at the rate of 12 gallons per day for each inhabitant. As there is no separate rate for baths, it is impossible to say how many may exist in Leeds, but a few months ago there were 1061 water-closets. The whole cost of the works up to September, 1857, was £283,871. 2s., which shows that for every pound expended there is a daily supply of about seven gallons. The receipts for the year 1857 were £17,467; the expenses, including interest on mortgages, £14,638. There is no compulsory rate in Leeds, the taking or not of water being voluntary. The charge for an unlimited supply to a cottage of £5 a year rent is scarcely more than one penny per week, and to a house under £30 of sixpence per week.

With respect to the cities and towns situated in the northern portion of the island, we shall shortly allude to the water-works of Edinburgh, Aberdeen, Dundee, Greenock, and Paisley, and conclude with a short account of the present and prospective works at Glasgow.

The supply of water to

EDINBURGH

is drawn exclusively from the Pentland Hills and the slopes on the east and north sides, and is brought to the city in four large main pipes by gravitation, and is under the charge of a private company. The average daily supply may be taken at 4,800,000 gallons. The delivery has been as high as 5,760,000; but the drought of the last summer has been so long continued that for several months past it has been a trifle under 4,000,000 gallons. The population within the bounds of supply may be taken at 215,000. A large portion of that number, probably between a third and a fourth, are supplied either from private sources or from the public wells. The persons supplied by payment do not exceed 160,000. Taking, however, the number of persons within the bounds of supply and the supply itself, we find that there are about 22 gallons for each inhabitant. The gross cost of the undertaking is £456,000, which shows 10½ gallons for every pound expended. The number of baths and water-closets supplied is not known, as no specified charge is made for these, but they are very numerous. The waste of water from carelessness and abuse is very great, not less than a third of the whole supply being uselessly, and in many instances worse than uselessly, wasted. At the present moment the company is engaged in bringing in an additional supply, which will add in November next about 2,000,000 gallons to the daily delivery, and which will make the daily supply about 7,000,000 gallons, or a daily supply to each inhabitant of 32½ gallons. There are few cities where the consumption of water has increased in a greater ratio to the inhabitants than in Edinburgh; and it is stated that if the consumption continues to increase as it has done during the last ten years, a similar difficulty will be felt there as elsewhere to meet this perhaps uncalled-for demand.

ABERDEEN

draws its supply of water from the river Dee, by pumping. The average daily supply is about 1,200,000 gallons, and the population within the limits of supply being about 65,000, gives 18½ gallons for each inhabitant. The whole cost of the works since their commencement in 1830 has been £50,000, which shows a daily supply of 24 gallons for every pound expended. The revenue raised for payment of management, interest, and expenses connected with these works, is chiefly by a rate of 9d. per pound on dwelling-houses, and 6d. per pound on shops, &c., an additional charged being made of 6d. per pound when water is supplied within the premises. The water supply is under the management of the Police Commissioners.

DUNDEE

is supplied with water from Monikie, about ten miles distant, by gravitation. The average daily supply is 1,750,000 gallons, and the population supplied is estimated at 96,000, which gives about 18 gallons for each inhabitant. The water-works are in the hands of a joint-stock company, who has expended on them £139,000, which shows a daily supply of upwards of 12½ gallons for every pound expended. The scale of charges is 1s. 2d. per pound on dwelling-houses above £6 of rent, while the lowest rate, on houses of £2 rent, is 4s. 6d. per annum.

GREENOCK

is supplied by the Shaws Water Company and the Corporation, by gravitation. The average daily supply is, by

Shaws Water Company	1,850,000 gallons.
Corporation	262,500 „
	2,112,500 „

and the population within the limits of supply being 40,000, gives nearly 53 gallons for each inhabitant. The gross cost of the works was about £50,000, but this sum includes the power of supplying mills, sugar-houses, &c. Assuming, however, this as the cost, it shows that for every pound expended there is a daily supply of 42 gallons. The annual expense is paid by a rate of 1s. per pound on the rental of all houses using the water supplied by the Shaws Water Company, and of a small additional rating on the part of the corporation for the water furnished by them through the public wells. The houses of the poorer class, say of £5 and under, are supplied by the corporation. All the others, who have water inside, are supplied by the company. The poorer class may, therefore, be held as taxed at 6d. in the pound, and the better classes at 1s. for water supply, which is abundant.

PAISLEY

is supplied with water by gravitation. The average daily supply is 1,021,452 gallons, and the population within the bounds of supply being 48,450, gives 21 gallons for each inhabitant. The gross cost of the undertaking was £60,000, which shows that for every pound expended there is a daily supply of 17 gallons. The works are in the hands of the Corporation and the annual expenditure on them is raised by a domestic rate of 1s. 3d. per pound on all lodgings, by a public rate of 3d. per pound on every description of property, by a special rate for horses, cows, warehouses, &c., and by a metre rate for trade purposes. The whole revenue last year was £5708. 15s.

Previous to the year 1806,

GLASGOW

was but indifferently provided with water. At that time it depended wholly for its domestic supply on twenty-nine public and a few private draw wells, and on the produce of a suburban spring, which was carted to the city and sold from door to door. About that period a water company was formed, to draw water from the Clyde, and to distribute it through the town; and in a few years thereafter a competing company was established for the same purpose, which in the course of time united, and the amalgamated companies continued to monopolize the whole supply till the establishment, in 1846, of another company, limited to supply the south side of the city, on gravitation principles. For some time the two original companies did their best to meet the growing demands of a growing city; and it will not be denied that, while they succeeded in furnishing quantity, the quality was seriously complained of, while the latter company had only a limited supply to offer, and that confined to scarcely a fourth part of the city. To obviate this state of things, the larger company attempted frequently to obtain

powers to draw their supply from a purer source; but being unsuccessful in their endeavours, it was at last determined that the works of both companies should be handed over to the municipality by a parliamentary Act, which at the same time contained powers to that body to bring a pure and abundant supply of the primary necessity of life from Loch Katrine, and which when completed will be one of the best and mightiest hydraulic undertakings in the world.

At present Glasgow is supplied, as we have hinted, from two sources—from the river Clyde, by pumping, and from streams collected into reservoirs, on the south side of the city, by gravitation, the nominal power used in pumping being 1000 horses. The highest houses in the city, which may be stated at 275 feet above the level of the river, are all supplied. The length of pipeage in use for its distribution exceeds 130 miles, exclusive of those places where two sets of pipes yet remain, the result of competing companies. The daily supply within these last two years has ranged from 16,119,000 to 17,301,000 gallons, and the population within the boundaries of supply may be reckoned at 420,000, thus showing a gross daily supply for each inhabitant of 40 gallons; or, deducting one-sixth for trade purposes, leaves, including waste, &c., no less than 33 gallons for each consumer. During the last eighteen years, the increase of supply and use of water on the part of the inhabitants has been prodigious, the whole quantity distributed in 1830 being 4,500,000 gallons daily for a population of about 200,000, while at the present day it exceeds 17,000,000 gallons per day for a population of 420,000, or twice the quantity per head in less than twenty years. To account in some measure for this great and growing use of water in Glasgow, it may be stated that in 1852, from a careful survey then made, there existed within the boundaries of the city no fewer than 6138 private plunge and shower baths, and 12,144 water-closets; and as the number of separate dwellings have since that period increased to the extent of at least 10,000, coupled with an increasing demand on the part of householders for these conveniences, it will not be too much to say that Glasgow cannot have less than 8000 of the former and 16,000 of the latter. The use, indeed, of these luxuries is not confined to the rich and middle classes, but extends even to the houses of the working man, whose annual rent is only £5. 5s.; and the consequence is, that a vast and increasing consumpt of water has taken place, arising, it is to be feared, in too many instances from utter carelessness and waste. The cost of the water-works at present supplying Glasgow, on the 28th of May, 1858, was £651,199, which shows that for every pound sterling expended there is a daily supply of about 26 gallons. The revenue, which is derived chiefly from a rate, amounted last year to £71,413. The expenditure, including interest on capital, but exclusive of the new works connected with the Loch Katrine supply, amounted to £66,566.

Such is the supply and cost of the existing water-works of Glasgow, which, although abundant and large, have not deterred its citizens from drawing their future supply of water from a distant and purer source, and upon principles which will not only free them from the expense of pumping, but will, at the same time, afford a supply to the highest house in the city. The idea of supplying Glasgow from the waters of a highland lake, free of all contamination, 37 miles distant, was first broached in 1848; but it was reserved for the genius of Mr. J. F. Bateman, the engineer of the Manchester Water-Works, to put the idea into execution. Amid surrounding mountains of micaceous schist, subjected to a great rainfall, and isolated from all population, he found, ready prepared, a great natural reservoir, almost free of cost and without danger. The superficial area of this reservoir extends to 114,940,000 square feet, and has a catchment basin of more than 35 square miles, to receive an annual rainfall of about 65 inches, and where the evaporation is so small a minimum product of 60 inches. By slightly raising the exit of Loch Katrine, and with a power of draining down the surface to three feet under its ordinary level, a reserve of 5,028,000,000 gallons are obtained, which secures a service of 20,000,000 gallons per day for 250 days of drought. The water is to be conveyed by mined tunnels, built tunnels, aqueducts, and pipes. The service reservoir is to be placed about six miles from Glasgow; and from the reservoir the water is to be conveyed by two lines of pipes, 36 inches in diameter. The surface of Loch Katrine is 360 feet above the level of the sea. The mean level of the ground on which the greater part of Glasgow is built is under 50 feet of that level. The average height of the houses may be taken at 50 feet. The extreme height of the ground at various points within the range of the distribution of water is 225 feet above high water, making the extreme height at which the water has to be delivered 275 feet above the level of the sea. The tunnels and conduits for conducting the water from Loch Katrine to Glasgow are capable of carrying 40,000,000 gallons a day, but the pipes are at present only laid for 20,000,000; but when more water is required, the addition of the pipeage portion only will require to be doubled. The cost of these new works is estimated at about £700,000; and, limiting the supply to 20,000,000 gallons, shows that for every pound sterling expended there will be a daily supply of 28½ gallons. As these works are now fast progressing, it is almost certain that the whole will be completed early in 1860. When that occurs the daily water supply will be as follows:—

From the Clyde	13,000,000
„ Gorbals	4,000,000
„ Loch Katrine	20,000,000
In all	37,000,000

But dispensing, as is proposed, with the Clyde supply, and thus getting rid of the expense of pumping, there will still remain 24,000,000 gallons per day, with a power of increasing it by gravitation to 44,000,000. With such a mighty store, it seems almost absurd to suppose that under any circumstances the supply should not be able to meet the demand; but when we recollect the wonderful increase of population which has taken place in Glasgow since the commencement of the century—an increase from 70,000 to 420,000—and the still more wonderful increase in the ratio of the consumption to the population, we do not think it at all improbable that Glasgow may feel ere many years, as New York does now, that she has not a gallon to spare!

Such is the amount of the water supply, and its cost, for the several cities and towns we have mentioned, and which we now place in a tabulated form for reference:—

Towns.	Population within Bounds of Supply.	Daily Supply.	Daily Supply for each Inhabitant.	Cost of Undertaking.	Daily Supply for every £1 expended.	Prospective Supply Daily in Addition.
		Gallons.	Gallons.	£	Gallons.	Gallons.
London	2,667,917	81,025,842	30·3	7,102,823	11·4	—
Paris	1,100,000	26,350,000	24·	800,000*	33·	20,000,000
Hamburg	160,000	5,000,000	31·25	170,000	29·50	—
New York	713,000	28,000,000	39·27	1,800,000	15·5	—
Manchester	500,000	11,000,000	22·	1,300,000	8·5	14,000,000
Liverpool	500,000	11,000,000	22·	1,640,000	7·	—
Leeds	153,000	1,850,000	12·	283,871	7·	—
Edinburgh	215,000	4,800,000	22·3	456,000	10·5	2,000,000
Aberdeen	65,000	1,200,000	18·4	50,000	24·	—
Dundee	96,000	1,750,000	18·2	139,000	12·5	—
Greenock	40,000	2,112,500	52·8	90,000	23·4	—
Paisley	48,450	1,021,452	21·	60,000	17·	—
Glasgow	420,000	16,710,000	39·8	651,199	26·	20,000,000

And now, in conclusion, let me state that, from the statistical figures just given connected with the water supply to great towns, the following results may be drawn:—

1st. The fact of a present prevailing anxiety for an abundant and pure supply of water, irrespective of every difficulty, and at any cost.

2nd. The fact of a growing consumption of water on the part of those who have had it at command, and the necessity of limiting as far as possible the quantity allowed to run to waste.

3rd. That while the increasing abundance of water has necessarily added to the comfort and health of the people, by enabling them to have baths and other conveniences easily and cheaply, it has at the same time tended to encourage city and house impurities being improperly carried away, and that too in a manner calculated rather to transfer than to abolish nuisance.

4th. That an abundance of water brought within every house, without due attention being paid to the carrying off to a distance or otherwise separating the solid sewerage from the water before it falls into any stream, is a serious and growing evil, which ought to be forthwith remedied, particularly on the part of those towns and villages which line rivers from which other towns are deriving their supply of water; and

5th. That an abundant supply of water is, in short, a limited benefit, except provision be at the same time made for a perfect and profitable riddance of the increased sewerage which it invariably creates.

* Independent of the cost of Canal de l'Ourcque.

Price Current.

CASTINGS, per Ton.

Average Weight of Cast-Iron Gas-Pipes, per Yard.

1¼ in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in
16	21	28	33	51	70	89	107	126	149	177	208 lbs.

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow.	Newcastle.	Wales.	Yorkshire, Derbyshire, and Staffordsh.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Pig Iron, No. 1	4 10 0	2 14 0	3 0 0	4 0 0	4 5 0
1¼ and 2 inches Socket-Pipes	7 15 0	7 0 0	7 5 0	7 10 0	7 5 0
2½ and 3 „ „	7 5 0	6 15 0	7 0 0	7 5 0	7 0 0
4 and 5 „ „	7 5 0	6 10 0	6 15 0	7 0 0	6 15 0
6 in. and upwards „	7 0 0	6 5 0	6 5 0	6 15 0	6 5 0
Retorts, 1st fusion, hot blast	6 15 0	...	6 15 0	7 0 0	6 15 0
„ 2nd „ cold „	7 15 0	...	7 0 0	7 5 0	7 0 0
Tank Plates, ⅜ thick and above	7 5 0	6 10 0	6 15 0	7 0 0	6 15 0

WROUGHT-IRON TUBING,

Subject to 40 per cent. Discount.

	2 in.	1½ in.	1¼ in.	1 in.	¾ in.	½ in.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Patent Welded Tubes, from 2 to 12 ft., perft.	1 8	1 0	0 10	0 7	0 5	0 4½
„ „ „ 6 in. to 18 in., each	3 0	2 0	1 9	1 3	1 0	0 9
Connecting-Pieces, or Long Screws	3 6	2 3	2 0	1 6	1 2	0 11
Bends, Springs, and Elbows—wrought iron	3 9	2 3	1 9	1 0	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 10
Crosses, wrought or cast	4 6	3 0	2 6	2 0	1 6	1 2
Iron Cocks	17 6	9 6	7 6	4 6	3 3	2 6
„ with brass plug	28 0	16 0	13 0	7 0	5 6	4 6
Diminishing Sockets, Caps, Plugs, and Plain Sockets [Nipples	1 3	0 9	0 8	0 6	0 5	0 4
Syphons, 2 quart	1 0	0 8	0 7	0 5	0 4	0 3
	15 0	14 0	13 6	13 0	12 0	—

COALS, per Ton.

Newcastle.—Unscreened.		*Scotch Cannel.*	
Whitwell Primrose	6s. 3d.	Boghead, at Leith	32s. 0d.
Medomsley, Eighton Moor, and Burnhope	6 6	Kirkness, best	23 0
Pelaw	6 9	Capeldrae, 1st quality	20 0
New Pelton, Peareth, South Pelaw, Washington Hutton, and South Peareth	7 0	„ 2nd „	12 6
Pelton	7 9	Lesmahago, at Glasgow	25 0
Ramsay's Newcastle Cannel	16 0	„ „ Leith	27 6
		Arniston	22 0
		Wemyss	20 0
		Knightswood	18 0
		Pirnie	15 0

SUNDRIES.

Best Newcastle Fire-bricks	per 1000	60s.	0d.
„ „ „ clay	per ton	12	0
Cliff's Fire-bricks, at Wortley	per 1000	57	6
Ingham's Fire-bricks, at Wortley	„	55	0
Tough Cake Copper	per ton	£98	0s.
English Pig Lead	„	21	0
Welch Bar Iron, in London	„	7	5
Tarred Rope Yarn	per cwt.	26s.	0d.
Foreign Spelter	per ton	£22	10s.
English Block Tin	„	121	0
Banca	„	122	0

FREIGHTS.

Coastwise—Newcastle.—Per Ton.		*Foreign.—Per Keel.*	
Chatham & Rochester	6s. 9d.	Boulogne & Calais	£7. 10s. to 8 10s.
Cork	8 0	Barcelona	21 10
Dover	6 0	Bordeaux	14 0
Dublin	9 0	Cadiz	15 0
Exeter Quay	8 0	Copenhagen	8 0
Folkestone	7 0	Dieppe	£9 to 9 10
Hastings	—	Genoa	20 0
London	6s. 6d. to 7 0	Hamburg	£8. 10s. to 9 0
Lowestoft & Yarmouth	5 0	Havre	9 5
Lynn	6 0	Leghorn	18 0
Portsmouth	7 6	Lisbon	15 0
Plymouth	7 6	Rotterdam	11 0
Whitstable	6 0	Stettin	8 0
Weymouth	—	Trieste & Venice	£21 to 22 0

THE MANCHESTER GAS COMMITTEE.—Three vacancies having occurred in this body, they were filled up at the first quarterly meeting of the City Council held after the elections, by the nomination of Messrs. Cottrell, Rumney, and Dyson. The two last were strongly objected to by Mr. Alderman Shuttleworth, the chairman of the committee, in consequence of the prominent parts they have taken in the recent agitation on the gas question, but their nomination was ultimately carried without a dissentient voice.

ACCIDENT AT THE NORWICH WATER-WORKS.—The following official explanation was sent for insertion in the local papers on the 5th instant:—"On Tuesday week the crank-shaft of the engine at the water-works broke in two. It was repaired, and the engines started again on the Thursday morning; but after working some hours, it was discovered that the breaking of the crank had cracked the piston, for this gave way and broke the piston-rod. A new piston and rod were immediately put in, and the engines started again on Tuesday morning with the repaired crank, which had been much damaged by the breaking of the piston-rod; but it was determined to work temporarily, in order that the inhabitants might have water. On Thursday morning the damaged crank broke the piston-rod, but this accident was anticipated. A new crank had been obtained from Dudley, and was now put in with a new piston-rod. The engines are now in a sound condition, and commenced filling the mains at 11.45 this morning. When the first accident happened the reservoir was full. On the Thursday and Friday 1,000,000 gallons of water were pumped into the city, and at the temporary start on Tuesday, 750,000 gallons."

THE MAIN DRAINAGE OF THE METROPOLIS.—Advertisements have been issued calling for tenders for the construction of nearly nine miles of the high-level intercepting sewer, and at a recent meeting of the board Mr. Bristow brought up a report from a committee, specifying the names of the engine manufacturers who had been invited to tender for the designing, constructing, and erecting boilers, engines, and pumps, within the metropolitan district, for lifting the requisite amount of sewerage water. He wished it to be understood on the part of the committee, that although they had only written to sixteen eminent firms at the present time, they reserved to themselves the right of reaching the number of twenty prescribed by the former resolution of the board. The following are the names of the manufacturers written to for tenders:—Messrs. Boulton and Watt, Soho Works, Birmingham; the Butterly Company, Alfreton, Derbyshire; Forrester and Co., Liverpool; Hick and Co., Bolton; Simpson and Co., Pimlico; Maudslay and Co., Lambeth; Rennie and Co., Holland Street, Blackfriars Road; Humphery and Co., Deptford; Mr. Laurie, Glasgow; Messrs. Harvey and Co., Hayle, Cornwall; Napier and Co., Glasgow; Hawkes Crawshay and Co., Gateshead; Whitham and Sons, Kirkstall Road, Leeds; Mr. Kay, Bury, Lancashire; Hawthorne and Co., Newcastle-on-Tyne; and Easton and Amos, The Grove, Southwark.

Advertisements.

By Her Majesty's Royal Letters Patent.

JOSEPH BOULTON, Patent Dry GAS-METER MANUFACTURER, and also Maker of his Improved WATER METERS.

No. 28, BAGNIGGE-WELLS ROAD, CLERKENWELL, adjoining the Police Office.—Late of No. 1, Coppice-row, LONDON.

Experimental and Station Meters of any size made to order on the shortest notice.—Governors, Pressure Registers, Gas-cooking Stoves, and every description of Gas Apparatus.

J. JONES, Iron Merchant, 6, Bank- SIDE, has long been known to sell the following Castings at prices lower than any other house in London:—Socket and Flange Pipes, Bends, Branches and Tees, Syphons, Lamp-posts, Rain-water Pipes, &c.; also, Hot Water Pipes, Elbows, Tees, Cylindrical and Saddle Boilers, and every Fitting for the same. Drawings and Prices of the above on application to J. JONES, Iron Bridge Wharf, 6, BANKSIDE, near the Sourthwak Iron Bridge.

GEORGE CUTLER, Gasholder MAKER,
No. 8, WENLOCK-ROAD, CITY-ROAD, LONDON.

Contracts for Tanks, Gasholders, Roofs, Purifiers, and all descriptions of Gas Apparatus executed on the most reasonable terms. Improved Slide Valves, Steam, and Range Boilers, and Smiths' Work, of the best materials and workmanship.

BIRTLEY IRON WORKS, CHESTER-LE-STREET, DURHAM.

Manufactory for every description of Casting and Machinery for Gas Works and Water Works.

Warehouse in London for Cast-iron Pipes and Connections of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

Office in London, Mr. E. M. PERKINS, 78, Lombard Street.

R. LAIDLAW and SON, Gas ENGINEERS,

Iron and Brass-founders, and Manufacturers of Cast-Iron Retorts, Condensers, Exhausters with Engines, Scrubbers, Purifiers, Station-Meters, Cast-Iron Tanks, Gasometers, Valves, Cast-Iron Pipes, &c.

Consumers' Meters, both wet and dry, of improved construction.

Internal Gas-Fittings of every description.

ALLIANCE FOUNDRY, EAST MILTON STREET, GLASGOW.

ROBERT MACLAREN and CO., EGLINTON FOUNDRY, GLASGOW,

Manufacturers of all sizes of Cast-Iron Main Pipes, by an improved Patent. General Ironfounders, Gas Engineers, and Wrought-Iron Tube Makers.

EDWIN DIXON,
WOLVERHAMPTON PATENT WROUGHT-IRON TUBE WORKS,
Originally established in 1833,

Manufacturer of Gas and other Tubes, Fittings, and articles of every description belonging to Gas, Water, or Steam.

E. D. had the honour of receiving the

PRIZE MEDAL

awarded to this Manufacture by the COUNCIL of the GREAT ENGLISH EXHIBITION of 1851; and from the latter date has supplied many towns exclusively with GALVANIZED and other Tubes for Gas and Water, under GOVERNMENT ENGINEERS.

A City, containing 150,000 inhabitants,

has recently been entirely supplied with Tubes made at the above-named Works, and several others with populations nearly as great; in fact, the reputation now acquired induces this notice to the public.

Large Stocks generally on hand, averaging from one to three hundred thousand feet.

HYDRAULIC PRESS TUBES,

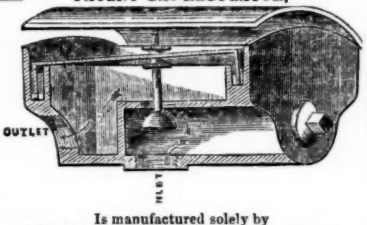
to resist 6000 lbs. and upwards to the square inch, extensively manufactured.

STOCK DIES and SCREWING TACKLE,

of the best possible description.

Every Tube carefully tested with Hydraulic Pressure before leaving the Works.

ESPLIN'S, commonly called Judkin's PATENT GAS-REGULATOR,

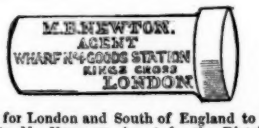


Is manufactured solely by
THOMAS LAMBERT and SON, Short Street, New Cut, Lambeth, LONDON,
And is by them supplied wholesale at the following prices:—

½-in. for 5 lights, 15s. 6d.	¾-in. for 10 lights, 25s. 6d.	1-in. for 20 lights. 34s. 6d.
1¼-in. for 30 lights, 48s.		
1½-in. for 60 lights, 65s.	2-in. for 100 to 150 lights, 93s. each.	

A saving in the consumption of Gas of from 20 to 25 per cent. is effected by the use of this Regulator.
A liberal discount allowed to the Trade.

J. CLIFF'S Fire Bricks, Clay RETORTS, &c.



Orders for London and South of England to be addressed to Mr. NEWTON, Agent for the District, 13, Westbourne Terrace, BARNSBURY PARK (N.).

N.B.—A few Retorts of each size, and a large stock of Bricks and Lumps, always on hand at the above Wharf.

GAS-WORKS ERECTED, ALTERED, VALUED, OR LEASED, BY

GEORGE WALCOTT, Gas and CONSULTING ENGINEER,
BEAUMARIS GAS-WORKS, ANGLESEA,

who has erected twenty Gas-Works during the last four years, all of which are giving satisfaction.
London Office, 24, Abchurch Lane, CITY.

METROPOLITAN BOARD OF WORKS.
MAIN DRAINAGE OF THE METROPOLIS.
NORTHERN HIGH-LEVEL SEWER.
TO BUILDERS, CONTRACTORS, AND OTHERS.

THE Metropolitan Board of Works hereby give notice, that they will MEET at the Council-Chamber, Guildhall, in the City of London, on FRIDAY, the 17th day of December next, at Twelve o'clock at noon precisely, and will then be prepared to open TENDERS by parties who may be willing to CONTRACT for the CONSTRUCTION of MAIN BRICK SEWERS, 8 miles 4:295 feet, or thereabouts, in length, and for the execution of other works in connexion therewith, to extend from the River Lea to Mansfield Road, Gospel-Oak Fields, near Hampstead; and for the maintenance of such works in complete repair for twelve calander months.

Plans, Sections, and a Specification of the Works, together with Forms of Tender, may be inspected, and other particulars obtained, at the office of the Board, No. 1, Greek Street, Soho Square, between the hours of Nine a.m. and Four p.m., until the 16th of December next.

The Engineer will attend at the Office of the Board on the 18th inst., at Twelve o'clock at noon, to afford further explanations to parties desirous of tendering, and to make arrangements for taking out the quantities.

Tenders, addressed to the Metropolitan Board of Works, must be delivered at the Office of the Board before Four o'clock on the 16th day of December next, and no Tender will be received after that hour.

The Board do not bind themselves to accept the lowest or any Tender, and the party whose Tender shall be accepted will be required to provide two approved sureties for the due performance of the works.

E. H. WOOLRYCH, Clerk of the Board.
No. 1, Greek Street, Soho Square, Nov. 10, 1858.

By Royal Letters Patent.

KAY'S Patent Equitable Gas-Meter is the most effective preventive of fraud by "tilting," and is as simple in construction as the common meter.

Manufactured only by
W. COWAN,
60, BUCCLEUCH STREET, EDINBURGH.

ALFRED PENNY, Engineer,
WENLOCK IRON WORKS,
WHARF ROAD, CITY ROAD, LONDON.

Mr. PENNY begs to inform Gas and Water Companies that he undertakes the erection of new, or the alteration of existing, works; and that he may be consulted generally on all matters connected with gas and water supply. He is also prepared to supply best Cold-blast Retorts, Socket-Pipes, and Connections, Iron Borings, &c. &c., and all the necessary Castings used in Gas and Water-Works.

*** Country orders executed with care and despatch.

WEST and GREGSON, Gas-Meter MANUFACTURERS, &c.
UNION STREET, OLDHAM.

Station and Experimental Meters, Gas Pressure Registers, Gauges, Experimental Gasholders, Governors, Slide Valves, &c. &c.

W. and G. would respectfully call the attention of Gas Engineers and Managers to their Station-meters, having made and erected the largest in use at the present time, two of which may be seen at the Stockport and Liverpool Gas Works, on application to the respective Engineers.

WHITEHOUSE and CO., Boiler and GASHOLDER MAKERS,
GLOBE PATENT TUBE WORKS,
WEDNESBURY,

Beg to draw the attention of Engineers and Managers of Gas Works to the superior quality of the Article they manufacture, both in respect of the iron employed, and the perfect manner in which it is welded; in proof of which they can refer to the testimonials of the most eminent Gas Engineers, and the experience of the principal of the large Gas Companies of the kingdom.

Orders promptly executed.

WILLIAM RYDER, General MINERAL AND METAL AGENT AND MERCHANT, 4, DEAN STREET, NEWCASTLE-ON-TYNE,

is prepared to supply Gas and Water Companies with Apparatus and Appliances of every description, including Cast and Wrought Iron Goods, Coals, Fire-Bricks, Retorts, &c. &c.

Any communications addressed to him as above shall have prompt attention.

NOW READY,

VOL. VI. of the JOURNAL of GAS LIGHTING, WATER SUPPLY, and SANITARY IMPROVEMENT, for 1857, price 21s., bound in cloth and lettered. A few copies of Vols. II., III., IV., and V. are still on sale.

W. B. KING, 11, Bolt Court, Fleet Street.

LONDON OFFICE:
162, STRAND, NEAR SOMERSET HOUSE.

M. SHEEN, Gas and Railway Lantern Maker, 90½, Holborn Hill, begs to inform Managers of Gas-Works, &c., that she continues to contract and supply Lanterns on reasonable terms, and keep them in repair by the year.

PATENT FLEXIBLE GAS TUBING,
VULCANIZED INDIARUBBER HOSE-PIPES,
WASHERS, PACKING, &c.

JAMES LYNE HANCOCK begs to announce a considerable REDUCTION in PRICE of his PATENT VULCANIZED INDIARUBBER TUBING.

VULCANIZED INDIARUBBER AIR-TIGHT BAGS, any size, for Gas Mains, with flexible tubes attached, and fitted with stop-cocks complete.

Manufactory and Warehouse, No. 6, Goswell Road, LONDON (E.C.).

THE PURIFYING-HOUSE SUPERSEDED.

MR. LAMING (Inventor of the Revivified Oxide of Iron Purification) has the satisfaction to announce that Gas may now be purified in a manner that combines unusual commercial advantages with all the possible requirements of the sanitary officer and the public. All that need be said to call attention to the new process is, that instead of the purifying-house, two vessels of small area, placed after the condenser, suffice; that these vessels never have the least communication with the atmosphere; and that neither lime, oxide, nor any other substance foreign to the gas itself is brought into contact with it. Gas engineers will perceive among the advantages thus offered, economy in room, labour, and materials; impossibility of nuisance; and total absence of injury to the illuminating power.

Particulars by addressing RICHARD LAMING, 118, FENCHURCH STREET.

WALTER MABON, Engineer,
ARDWICK IRON WORKS, FAIRFIELD STREET,
MANCHESTER,
Manufacturer of
IRON TANKS for Gasholders, Railway Stations, &c.
GASHOLDERS.—Extensive premises at Gorton, solely for the manufacture of Gasholders, and other heavy Wrought-Iron Structures.
GAS APPARATUS.—W. M. has an extensive assortment of patterns for Purifiers from 4 feet to 15 feet square, also round ones from 4 feet to 10 feet diameter; Scrubbers, Condensers, Washers, Columns, Girders, and Tripod Patterns, suitable for Gasholders, from 10 feet to 150 feet diameter, either Single-lift or Telescope. Contractor for Gas Works of any Magnitude. Designs, Specifications, and Estimates furnished.
WROUGHT and CAST IRON ROOFS for Railway Stations, Gas Works, Warehouses, and Sheds, prepared for Slates or for Corrugated Iron.
IRON HOUSES, either for Dwellings, Manufactories, or Public Buildings.
PIPES and VALVES, for Gas and Water, from 2 inches to 48 inches bore.

NO CHIMNEY WANTED FOR
RICKETS'S PATENT CALORIFERE GAS STOVES,
IN CHURCHES, HALLS, OR SHOPS;
And for Conservatories, or any close apartment, a pipe can be attached to convey away the burnt air.
RICKETS'S CHEAP GAS STOVE,
Price £1. 15s.,
Made of sheet-iron, suitable for heating small Counting-houses, Bed-rooms, Cellars &c. &c.
MANUFACTORY,
AGAR STREET, STRAND, LONDON.

JOHN ROGERSON and CO.,
NEWCASTLE-ON-TYNE & MIDDLESBRO'-ON-TEES.
Wrought and Cast Iron Pipes, Cast-Iron Retorts, and all kinds of Foundry Work necessary for Gas-Works. Fire-Bricks and Clay Retorts. Gas Coals of every description. Pig, Bar, and Plate Iron.

BRYAN DONKIN and CO.'s improved GAS VALVES have been adopted by numerous Gas Companies in England and abroad, and their advantages and great security fully proved. Very large numbers are in use. Prices from 11s. 6d. to 13s. 6d. per inch diameter.
BRYAN DONKIN and Co.,
Engineers, near Grange Road, BERMONDSEY.

GEORGE ANDERSON, Gas and CONSULTING ENGINEER,
104, LEADENHALL STREET, LONDON (E.C.).
DIRECT-ACTING GAS-EXHAUSTERS,
supplied either with or without Steam-Engines and Boilers.
FOUR-WAY DIAPHRAGM VALVES,
one of which answers the purpose of THREE ordinary Valves, as applied to Purifiers, or in shutting off and passing Station-Meters, Governors, or other apparatus, while the Connecting-Pipes are also much simplified.
RETORT SETTINGS,
designed to be heated by Tar alone, and with a total absence of Smoke.
Illustrated circulars, giving references and every information, may be obtained on application as above.

By Her Majesty's Royal Letters Patent.

JAMES MEACOCK,

PATENT DRY and IMPROVED WET GAS-METER WORKS,

7, SNOW HILL, AND 16, WEST STREET, LONDON.

ESTABLISHED 1836.

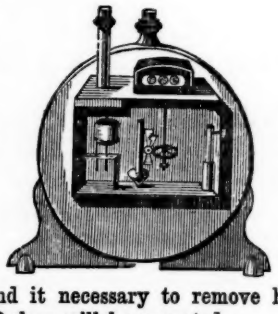
J. MEACOCK begs to call attention to his patent method of securing the Leather diaphragm of his Dry Meter. Instead of using the soldering iron for this purpose, it is held between two flat Metal Rings, and screwed up sound to a metal frame, as shown in the drawing.

By this improvement the perishing effect of hot tools to leather being avoided, its durability must be longer; also, its repair when needful is most simple, as a new leather diaphragm can be applied by merely unscrewing the old one from the rim or frame to which it had been screwed up.

Meters of Gas Companies being subject to so much wear and tear, J. M. begs leave to assure those who may honour him with their commands, that nothing but the stoutest materials for cases, the hardest gas-resisting metals, and best foreign leather for the interiors, will be used, and none but first-class workmen employed in their construction.

Wet Gas-Meters Repaired and Reconstructed with J. Meacock's Modern Improvements.

METERS SENT ON APPROVAL.



In consequence of the great demand for the above Meters, J. Meacock has found it necessary to remove his Manufactory to more extensive Premises, 16, West Street, Smithfield, where Orders will be executed on the shortest notice.

ADDISON POTTER,
WILLINGTON QUAY,
NEAR NEWCASTLE-UPON-TYNE,
Manufacturer of Clay Retorts, Fire Bricks, and every description of Fire Clay Goods.

WATER-WORKS, BURY ST. EDMUND'S.

THE Commissioners for Lighting, Cleansing, and otherwise improving the Town of Bury Saint Edmund's, in the County of Suffolk, are desireus of CONTRACTING with any Company or Person for a supply of WATER for Public or Municipal Purposes, for a term of years, to be delivered at such places in the town as the said Commissioners shall determine upon. And the Commissioners will give to such Contractors all facilities for laying down Mains and constructing Works for the supply of such Water, in accordance with the Act of Parliament, and also for the supply for private consumption. And the Commissioners will be ready to pay a sum not exceeding £150 per annum, for the supply of such quantities of Water as they shall require for Watering and Cleansing the Streets, Flushing of Sewers, and any other Public or Municipal use.

The Specification of the Terms of Contract for the supply for the use and requirements of the Commissioners, and of the conditions to be observed by a Company or other Person willing to undertake the domestic supply of Water to the Town, may be seen at my Office, No. 7, Hatter Street, BURY ST. EDMUND'S, where Tenders are to be delivered on or before the 1st of December next.

JAMES SPARKE,
Solicitor and Clerk to the said Commissioners.

NORWICH UNION LIFE INSURANCE SOCIETY.—Instituted 1808.
Invested Capital exceeding £2,000,000 Sterling.
This Society is one of the very few purely Mutual Insurance Offices, the whole of the profits being divided among the Policy holders.
The rates are considerably below those usually charged. Thus, at the age of forty, the sum of £32. 19s. 2d., which at the ordinary premium will insure £1000, with the NORWICH UNION WILL INSURE £1095. 4s., giving an immediate Bonus in addition to subsequent accumulations.
Annuities and Special Risks undertaken on favourable terms.
For Forms of Proposal and Prospectuses apply to the Society's Offices, 6, Crescent, New Bridge Street, BLACKFRIARS, E.C., and Surrey Street, NORWICH.

TO THE GAS COMPANIES
OF GREAT BRITAIN AND THE CONTINENT.

CANNEL AND COAL FOR GAS PURPOSES.—Fifteen years' connexion with one of the largest Gas Concerns in England, enables us from practical experience to certify that the CANNEL and COAL we offer are those best suited for Gas purposes.
On application, we shall have much pleasure in forwarding our Tabulated Statements of Analyses, with Prices and Terms; also References as to respectability.
All Contract Orders have our careful and best attention.
EMANUEL TURNER and Co., Exporters of Cannel and Coal, 34, Castle Street, LIVERPOOL.

HARRIS and PEARSON,
PROPRIETORS OF
BEST CLASS-HOUSE POT AND CRUCIBLE CLAY.
MANUFACTURERS OF
FIRE BRICKS GAS RETORTS &C.
AMBLECOTE FIRE CLAY AND BRICK WORKS,
STOURBRIDGE.
Late in the occupation of I. and W. King. Originally J. Pidcock, Esq.

BENJAMIN GIBBONS, Jun.,
DEEPDALE FIRE-CLAY & BRICK WORKS
Near DUDLEY,
Manufacturer of every description of Fire-Bricks, Lumps, Quarries, Shields, Flue Covers, &c., to any size or shape required.
FIRE-CLAY RETORTS,
TO MODEL OR DRAWING.
B. G. begs to call the attention of Gas Companies to his Fire-Clay Retorts, which have been used with great satisfaction in some of the largest Gas-Works in the Metropolis and many Provincial Towns in England.
References given, if required.

CEMENT.

G. and T. EARLE, Hull, beg to draw the attention of Gas and Water Companies, Engineers, and Contractors, to their Light Cement, for Stuccoing and Building Gasholder Tanks, and Jointing Iron Pipes, for which purposes it will be found a very superior article.

FIRE-CLAY GAS RETORTS.

ESTABLISHED IN 1795.

JOSEPH CLIFF,

WORTLEY FIRE-BRICK WORKS, near LEEDS.

THESE RETORTS are unrivalled in excellence, being the BEST FINISHED INTERNALLY, and THE MOST CORRECT IN FORM, of any in the Kingdom. From the peculiar composition used in working up the face of the material, they are rendered unusually smooth, close, and FREE FROM SURFACE CRACKS, thus, in a great measure, preventing leakage and the adhesion of carbon to their interior surface.

To meet the yearly increasing demand of UPWARDS OF THIRTY SEASONS and to carry out the late improvements in the manufacture, the Premises have been re-erected and much enlarged, and Engineers may rely WITH CONFIDENCE on their orders being completed with a greater regard to despatch than by any other House.

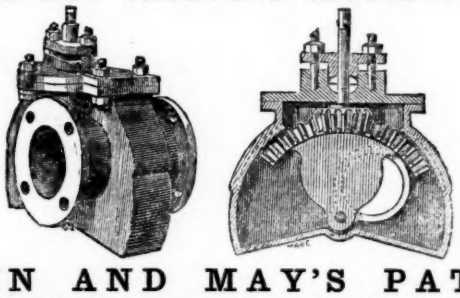
THE WORKS ARE WELL SITUATED

For EXPORT from the Ports of { LONDON, LIVERPOOL, HULL, MIDDLESBRO', HARTLEPOOL, and STOCKTON.

FIRE-BRICKS, LUMPS, GUARDS, TILES, AND CLAY OF THE SAME QUALITY.

M. B. NEWTON, London Agent, No. 4, Wharf, King's Cross Goods Station.

BEST AND CHEAPEST SLUICE-COCK.



BROWN AND MAY'S PATENT.

Above 3-inch diameter, price 10s. per inch. Brass face, 6d. per inch extra.

Can be taken to pieces without being removed from the line of Piping.

NORTH WILTS FOUNDRY, DEVIZES.

Wholesale Agents, Messrs. S. and E. RANSOME, 31, Essex Street, Strand, E.C.,
Where a Sample may be seen.

WILLIAM PARKINSON AND CO.,

(Successors to the late Samuel Crosley,)

COTTAGE LANE, CITY ROAD, LONDON,

Beg to announce that, in addition to the manufacture of GAS-METERS, they continue the manufacture of METERS for MEASURING WATER, SPIRITS, &c., commenced, under Patent in 1849, by the late Mr. William Parkinson.

These Meters are as simple and durable as the Gas-Meter, and as correct as that instrument in the registration of the fluids passing through them.

JOHN BENT, Manufacturer of

GAS-METERS,
283, BELL BARN ROAD, BIRMINGHAM,
(Established 1830),

Begs respectfully to call the attention of Gas Companies, Engineers, &c., to his WET GAS METER, made upon the most improved principles, the most admirable materials, and warranted to register correctly.

"ALL DOUBTS REMOVED."

DEFRIES' celebrated Dry Gas-METERS,

of which there are 80,000 in use in Palaces, Churches, Chapels, Royal Dock-yards, Club Houses, Public Offices, and other buildings throughout the Empire, the Continent, and Colonies.

His meter for 1500 lights, in use upwards of ten years at the Royal Italian Opera, until that building was destroyed by fire, was long afterwards dug out of the burnt ruins, then tested by the Chartered Gas Company and found inflexibly correct.

On the 9th of June, 1858, at the Western Gas Company, his meter for 150 lights, after considerable use, was doubted, and subjected to the most variable tests, from the full lighting down to a single jet, and in each case, as in numerous other instances, accuracy was finely indicated.

His two large meters at the Thames Tunnel have been in constant use day and night for upwards of twelve years (one continuation of dark hours), subjected to the wear and tear of 75 years, as compared with the ordinary hours of using gaslight above ground.

Gas Companies honouring Mr. Defries with their commands for his PATENT DRY METER, which has done so much service in simplifying the fitting up of gas, as well as checking surreptitious burning, will be guaranteed perfection for five years free of charge.

Defries' Prize-Medal Gas Baths, Gas-Cooking and Heating Stoves. The Polytechnic Gas Fire, with indestructible fuel, in daily operation (Saturday excepted) at the Office, 145, REGENT STREET, and the Manufactory, Euston Road, Fitzroy Square, LONDON.

LIVESEY FIRE-CLAY WORKS,

NEAR BLACKBURN, LANCASHIRE.

ORLANDO BROTHERS,

MANUFACTURER OF PATENT CLAY RETORTS,

AND EVERY DESCRIPTION OF

TUBULAR GLAZED SEWERAGE PIPES, BENDS, JUNCTIONS ETC.

FIRE-BRICKS, TILES, BLOCKS, AND CHIMNEY-TOPS.

WILLIAM INGHAM AND SONS,

WORTLEY FIRE-BRICK AND RETORT WORKS,

Near

Leeds.

W. INGHAM and SONS, having for many years been extensively engaged in the Manufacture of

RETORTS AND FIRE-BRICKS FROM THE CELEBRATED WORTLEY FIRE-CLAY,

beg to call especial attention to their RETORTS, which have for many seasons proved to be unsurpassed in quality by any in the Kingdom, their FREEDOM FROM CRACKS and the ADHESION OF CARBON rendering them worthy the attention of all parties interested in the making of Gas.

The Works are of such magnitude as to ensure the prompt execution of orders to any extent.

Estimates for Setting, or Bricklayers sent when required.

GAS OVENS IN SEGMENTS OF EQUAL QUALITY.

London Agents: CHADWICK and AKEROYD, Willington Stone Wharf, Regent's Park Basin.

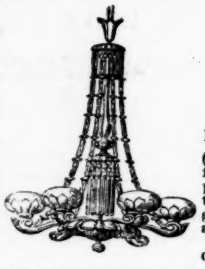
A large stock of Fire-Bricks, Fire-Clay, Terra Cotta, and Drain-Pipes of all sizes kept in London at CHRISTIE & CO.—Wharf, 64, Bankside, Southwark, where all particulars of Prices, &c., may be obtained.

N.B.—*Export orders continue to have prompt attention.*

ALEXANDER WRIGHT,

GAS ENGINEER, MANUFACTURER OF GAS-METERS, GOVERNORS, AND EVERY DESCRIPTION OF GAS APPARATUS,
55, MILLBANK STREET, WESTMINSTER.
CONSUMERS' METERS at the List Price, with a Liberal Discount to Wholesale Purchasers.
THOMPSON'S BROMINE TEST, £1. 1s.—BROMINE, 3s. per Ounce.
BISULPHURET OF CARBON TEST, £2. 2s.
APPARATUS FOR DETERMINING THE HEATING POWER OF SAMPLES OF COAL AND OTHER DESCRIPTIONS OF FUEL, £5. 5s.,
INVENTED BY LEWIS THOMPSON, ESQ., M.R.C.S.
REGISTERING PRESSURE GAUGE, Net Price, £8. Glass Shade, 10s. extra.
STATION METERS, PRESSURE GAUGES, PHOTOMETERS, SPECIFIC GRAVITY APPARATUS, &c.

JAMES OAKES and CO.,
ALFRETON IRON WORKS, DERBYSHIRE,
AND
WENLOCK IRON WHARF, 20. WHARF ROAD, CITY ROAD, LONDON,
Beg to inform Gas and Water Companies and the public, that they keep in stock in London all the CASTINGS in general use in Gas and Water Works, including best cold-blast Iron Retorts, Socket and Flange Pipes of all sizes, Bends, Branches, Syphons, Lamp Columns of various patterns, &c.
N.B.—Orders for Cast-iron Tanks, Girders, Columns, Cylinders, and all irregular castings, will have immediate attention.
CHARLES HORSLEY, Agent.
C. H. is prepared to carry out the warming and ventilation of public buildings, &c.; also civil engineering in general.

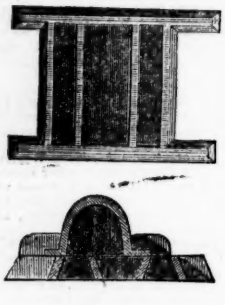


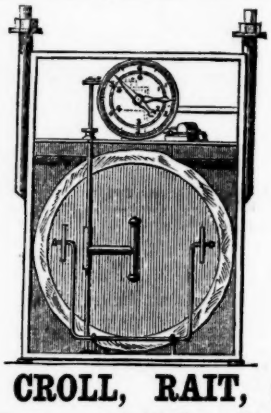
F. & C. OSLER,

44, OXFORD STREET, LONDON;
Manufactory—Broad Street, Birmingham—Established 1807,
MANUFACTURERS OF GLASS CHANDELIERS, GLASS LUSTRES, TABLE GLASS, &c. &c.
ELEGANT CRYSTAL GLASS CHANDELIERS, for GAS, from £4 upwards (Made from "REGISTERED" DESIGNS), with GLASS BRANCHES, &c.; suitable for DRAWING-ROOMS and BALL-ROOMS. The more extensive use of GAS in private dwellings has induced Messrs. OSLER to direct their particular attention to the manufacture of this class of articles—which, with a view to their general adoption, are offered at very moderate prices. Purchasers can select from a great variety of patterns, to which additions are being constantly made.
THEATRES, CONCERT, ASSEMBLY, AND BALL ROOMS LIGHTED BY ESTIMATE ON THE LOWEST TERMS.

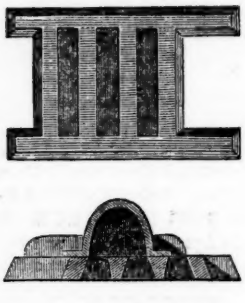
CROLL'S
PATENT IMPROVED DRY GAS-METER,

NEW VALVE.





OLD VALVE.



Manufactured by CROLL, RAIT, and CO., LONDON.

FACTORY—Blundell Street, near the Railway Station, Caledonian Road, N.
OFFICES—10, Coleman Street, City, E.C.

Messrs. CROLL, RAIT, and Co. beg to call the attention of Gas Companies to their Improvements in Dry Gas-Meters, which secure a steady light under all circumstances.

In forming the Valve-Seat of the Dry Gas-Meter it has hitherto been usual for the Bars to be equal in width to the openings; but, by the extent of the surfaces thus brought into contact with the Valve or Cover, it is found that fluid accumulates, and, during part of the motion of the Valve, partially closes the passage, thereby causing an oscillation in the lights.

An Improvement in the Manufacture now introduced and patented by Mr. CROLL consists of very considerably reducing the width of the Surfaces or Bars, as in the drawing of the New Valve, retaining only such width of bar as is necessary to secure correct measurement.

Another Improvement consists in the mode used of mixing and amalgamating the various proportions of Metals for the Valve, always taking care that the Valve-Seat shall be of an alloy considerably different to that of the Valve-Cover, by which the friction of the surfaces is materially lessened.

These Improvements remove at onee any liability to unsteadiness of light, and at the same time secure (from the Valve working more evenly) a greater certainty of accurate registration.

D. HULETT and CO., 55 and 56, HIGH HOLBORN, LONDON,

PATENTEES and MANUFACTURERS of the ONLY GOOD MERCURIAL GAS REGULATOR,
invite the attention of Gas Companies and the Trade generally to their Improved GAS-METERS, which they warrant equal to any in Quality, Workmanship, and Simplicity of Construction, and the only Meters from which Gas cannot be obtained without being duly registered.
MANUFACTURERS OF
GAS CHANDELIERS, GLASS LUSTRES, HALL LANTERNS, VESTIBULES, BRACKETS, PENDANTS;
DOUBLE CONE, ALBERT, SHADOWLESS, & EVERY DESCRIPTION OF BURNER, UNION JETS, BATSWINGS, ETC.
IMPROVED FULL-WAY CARTER'S VALVES (much approved of);
GAS-STOVES, and every article connected with Gas Apparatus.
CAST & WROUGHT-IRON PIPE, BLACK & GALVANIZED. COPPER, TIN, BRASS, & COMPOSITION TUBING.
D. HULETT'S IMPROVED SERVICE CLEANSER
for clearing out Mains, Services, and Interior Fittings—60s. net.
Boyle's Patent Silvered Glass Combination Reflectors and Outside Lanterns.
Sole Manufacturers of Church and Mann's Photometer.
Large Pattern Books, with every description of Gas-Fittings, Chandeliers, &c., with complete Book of Prices, 12s.

London: Printed by WILLIAM BOUGHTON KING (at the office of Joseph Clayton, 17, Bouverie Street, Fleet Street); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, November 23, 1858.